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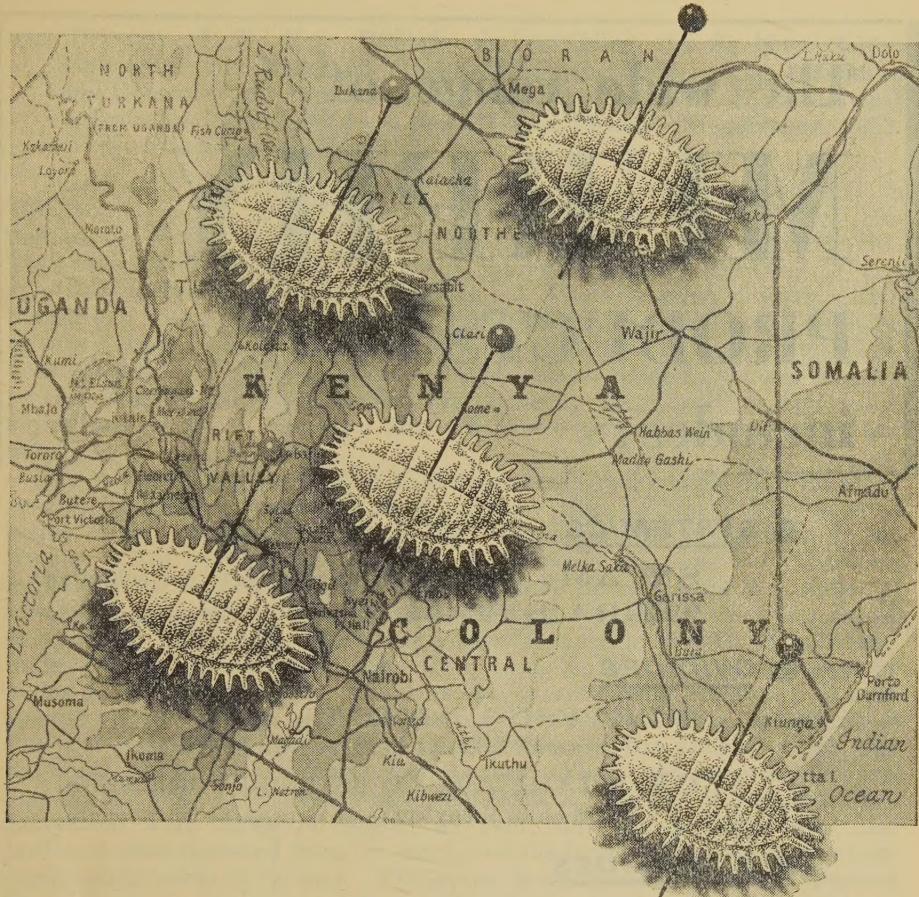
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VAN DINOTHER (J. B. M.). **Biologie en bestrijding van de bonenvliegen *Hylemyia cana* Macq. en *Hylemyia liturata* Meig.** [The Bionomics and Control of the Bean Seed Flies, *H. cilicrura* and *H. trichodactyla*.] —*Tijdschr. PlZiekt.* 59 pt. 6 pp. 217-232, 13 refs. Wageningen, 1953. (With a Summary in English.)

Considerable damage is caused to germinating beans (*Phaseolus*) in Holland by species of *Hylemyia*, and since little was known of their bionomics and control under local conditions, investigations were begun in 1951. The species found to be present were *H. cilicrura* (Rond.) (*cana* (Macq.)) and *H. trichodactyla* (Rond.) (*liturata* (Mg.)). Their synonymy, world distribution and food-plants are reviewed, and reference is made to the parasitic or predacious habits of *H. cilicrura* in warm climates. In addition to beans, both species were observed attacking cabbage and related crucifers (usually as secondary pests), lupin, maize, rye, spinach, wheat, and, exceptionally, clover and oats. *H. cilicrura* also sometimes attacked carrot, onion and radish.

The two species have similar bionomics, and observations were made on several thousand examples taken in nets and traps or reared from infested beans. They can be distinguished from each other only in the adult males. Among males captured in the field, *H. trichodactyla* was 2-15 times as numerous as *H. cilicrura*, and males of both species were 2-3 times as numerous as females. The sex ratio averaged 1:1 among examples reared from beans, which were apparently a more favourable food for *H. cilicrura*, males of this species reared from them being up to twice as numerous as males of *H. trichodactyla*. Adults of the overwintering generation of both species appeared early in April and were present until June, and those of the first generation emerged in July and those of the second, which was the most numerous, at the end of August. These two generations overlapped, and flies were present until mid-October. Adults of a partial third generation were taken in September 1951, but not in 1952. The flies preferred sites sheltered from the wind, and the females oviposited on or near germinating beans in the soil. The larvae hatched in 2-3 days and attacked the cotyledons, plumule and hypocotyl, the numbers per bean ranging up to nine and averaging four. Heavy infestation resulted in retardation of development or death of the seedlings. The larval stage lasted about 11 days, total development from egg to adult about 25 days at 20°C. [68°F.], and the preoviposition period about a fortnight. Hibernation occurred in the pupal stage.

Factors affecting infestation are discussed; it was discouraged by cold, wet weather, but newly-ploughed, loose soil and that containing decaying organic matter was particularly attractive for oviposition, and beans were often heavily attacked when sown shortly after spinach or lupin stubble had been ploughed in. The Cynipid, *Trybliographa (Cothonaspis) rapae* (Westw.), and the Staphylinid, *Aleochara bipustulata* (L.), were reared from puparia of both flies [cf. R.A.E., A 42 367]. The total percentage parasitism was about five in the autumn of 1951, when infestation was heavy, and 1-3 in spring and summer. Pupae parasitised by *A. bipustulata* and *T. rapae* were in the ratio of 1:12.

In control experiments in 1951, seed beans were treated with tar distillate or kerosene at 0.048-0.08 fl. oz. per lb. or (after wetting with an adhesive) with 10-20 per cent. by weight of a 50 per cent. DDT dust or 2-5 per cent. by weight of a 25 per cent. BHC dust, or the soil was treated with 5 per cent. DDT or BHC dust at 0.6-2.1 oz. per sq. yard. A field containing belts of maize as windbreaks was divided into small plots in which beans were sown at intervals of 10-14 days from May to early October, recovered 1-2 weeks later and examined for infestation. Infestation was light until the

end of August, the average percentage of beans attacked varying between about five and ten. All treatments retarded germination, and, because of this, infestation was 2-5 times as high in the DDT plots as in the controls. Tar distillate and kerosene were ineffective, but the BHC treatments gave some protection. Infestation was heavier in September and October, when the average infestation percentages were reduced from 22.5 and 25 in the controls to 14.1 and 16.6 for seed treatment and 17.2 and 19.8 for soil treatment with BHC at the highest rates of application. The other treatments were again unsatisfactory. Similar experiments were carried out in 1952 with aldrin and various γ BHC products, some combined with fungicides, as seed dressings, and γ BHC and dieldrin dusts and dry and liquid preparations of chlordane in soil treatments. Infestation was less severe than in 1951, but although it was reduced by all treatments, the differences were slight. Seed treatment was very slightly superior to soil treatment.

CALCAGNOLO (G.) & SAUER (H. F. G.). **Influência do ataque dos pulgões na produção do algodão.** [The Effect of Attack by Aphids on the Production of Cotton.]—*Biológico* 20 no. 2 pp. 21-31, 3 refs. São Paulo, 1954.

Aphids, principally *Aphis gossypii* Glov., are important pests of cotton in São Paulo. Infestation usually begins 20-30 days after germination, causing deformation and retardation of growth, and although these are largely overcome and the plants fruit apparently normally, the yield is reduced. Heavy infestation also causes reddening of the leaves, which dry up and fall, and this results in further loss of crop. The attack is sometimes delayed until the appearance of the buds and flowers, and although it then causes some shedding, the damage is less severe.

Experiments were carried out in 1952-53 to ascertain the loss of crop involved. In a small-plot test on cotton sown on 3rd November, a dust of 20 per cent. toxaphene (which did not affect the Aphids) was applied to all plots, 30, 40 and 50 days after germination to protect the plants from attack by *Eutinobothrus brasiliensis* (Hambleton). Sprays of 0.5 per cent. calcium arsenate, which is reputed to favour infestation by *A. gossypii* [cf. R.A.E., A 29 359], were applied to one series of plots at regular intervals in order to ensure the presence of Aphids if the untreated plots were not heavily infested, and sprays of 0.02 per cent. parathion were applied against the Aphids in another series at almost weekly intervals from the beginning of infestation, 20 days after germination, until it ceased in mid-February. From that time until picking, the toxaphene dust was applied alternately on all plots with one of a mixture containing 3 per cent. γ BHC, 10 per cent. DDT and 40 per cent. sulphur to protect the crop from other pests. Counts were made seven times between 18th December and 5th February, and the average numbers of Aphids per sq. cm. of leaf surface on the first and last dates were 0.47 and 0.01 for parathion, 9.45 and 2.59 for calcium arsenate, and 17.51 and 3.66 for the control plots, indicating that parathion gave almost complete protection and calcium arsenate some control. Picking began on 18th and 31st March in the plots treated with parathion and calcium arsenate, respectively, and on 5th April in the controls, ending in all cases on 15th May, and the total yields for no treatment against Aphids and for treatment with calcium arsenate were 44.1 and 16.5 per cent. less than that for treatment with parathion. Cotton from the control plot was of inferior quality, owing to retardation of growth and consequent attack by *Platyedra gossypiella* (Saund.) and *Dysdercus* sp.

A large-plot test was made simultaneously under field conditions. The toxaphene dust was applied against *E. brasiliensis* 25 and 45 days after

germination and alternately with the mixture of BHC and DDT against other pests from the end of infestation by the Aphids until picking. Sprays of 0·01 per cent. parathion were applied on 10th and 22nd December and 12th January either to the whole plant or to the tips only, the latter being the usual method among growers, and 0·2 per cent. Systox (50 per cent. diethyl 2-(ethylmercapto)ethyl thiophosphate) on 11th December and 17th January. The crop was picked between 18th March and 13th May, and the percentage reductions in yield as compared with that for complete treatment with parathion were 46·88 for the controls, 15·92 for Systox and 23·68 for parathion applied to the tips only.

MENEZES MARICONI (F. A.). **As lagartas-rosca. Pragas das plantas hortícolas.** [Cutworms. Pests of Vegetables.]—*Biológico* 20 no. 3 pp. 41-46, 6 figs., 8 refs. São Paulo, 1954.

In view of serious injury to a large crop of mint by *Agrotis repleta* Wlk. in 1951 and to cabbage, cauliflower, tomato and potato by *A. ypsilon* (Hfn.) in 1953, both in São Paulo, the bionomics and control of cutworms in general are reviewed from the literature.

DE TOLEDO (A. A.). **Eficiência do DDT no contrôle da broca da figueira (*Azochis gripusalis*).** [The Effectiveness of DDT in controlling the Fig Borer, *A. gripusalis*.]—*Biológico* 20 no. 3 pp. 47-49, 1 ref. São Paulo, 1954.

In further experiments in 1952-53 on the control of *Azochis gripusalis* Wlk. on fig in São Paulo [cf. *R.A.E.*, A 42 55], wettable-powder insecticides were added between 23rd September and 28th February to the fortnightly applications of bordeaux mixture. The figs were picked on 20th April, while still green, to avoid damage by birds, and the percentages of branches infested were then 0 and 6 for 0·1 and 0·05 per cent. DDT, respectively, 12 and 11·1 for 0·032 and 0·016 per cent. γ BHC as lindane and 42·6 in the controls. The yield of figs was not increased by the treatments.

LEIDERMAN (L.). **Observações sobre a suscetibilidade de cinco variedades de milho ao ataque de *Heliothis obsoleta* (Fabr., 1793) e *Diatraea* sp.** [Observations on the Susceptibility of five Varieties of Maize to Attack by *H. armigera* and *Diatraea* sp.].—*Biológico* 20 no. 5 pp. 73-77, 7 refs. São Paulo, 1954.

In tests in São Paulo in 1953-54 on the susceptibility of five varieties of maize to infestation by *Heliothis armigera* (Hb.) (*obsoleta* (F.)) in the ears and *Diatraea* sp., probably *D. saccharalis* (F.), in the stalks, two of three varieties in which the ears were well covered by the husks were less attacked by *Heliothis* than the remaining two, and one of them was also the least attacked by *Diatraea*. A sweet variety was the most heavily infested by both insects.

KOCHER (C.), ROTH (W.) & TREBOUX (J.). **Bestimmung kleiner Mengen Insektizide mit *Daphnia pulex* de Geer.** [The Determination of small Amounts of Insecticides with *D. pulex* (L.).]—*Mitt. schweiz. ent. Ges.* 26 pt. 1 pp. 47-55, 1 fig., 4 refs. Berne, 1953.

A bioassay method is described for the quantitative determination of insecticide residues of less than one part per million on or in plants. The

plant material is ground with anhydrous sodium sulphate, which removes the water, and boiled for 12 hours with diethyl ether, which extracts 95-98 per cent. of the insecticide. Ethanol is added to the water-free solution obtained, and the ether removed by distillation. Similar extracts are made from the same plants treated with a known quantity of insecticide in acetone and from untreated plants, and these are mixed in proportions calculated to give a graded series of concentrations corresponding to 0.05 or 0.1 p.p.m. insecticide in the plant material and upwards. The extracts are mixed with tap water at a maximum concentration of 1:1,000, examples of *Daphnia pulex* (L.) introduced, and the percentages rendered incapable of swimming by the known and unknown proportions of insecticide observed at intervals and compared. The tests are carried out at the temperature at which the examples of *D. pulex* are reared; *D. magna* Straus can also be used, but is less sensitive to insecticides.

Examples are given in which the method was used for measuring residues of Diazinon (O,O-diethyl O-2-isopropyl-4-methyl-pyrimidinyl(6) thiophosphate) and diethyl 2-(ethylmercapto)ethyl thiophosphate in cauliflower, Isolan (1-isopropyl-3-methyl-pyrazolyl(5) dimethylcarbamate) in peaches and parathion in cherries. Experiments showed that relatively high concentrations and long exposure periods were required for DDT, BHC and other chlorinated hydrocarbons to produce any visible reaction in *D. pulex*, and in comparative tests with known amounts of parathion with or without the addition of five times the quantity of DDT in cherries, the presence of the DDT did not influence the results within the tested range of 0.1-25 p.p.m. parathion.

BURCHFIELD (H. P.) & STORRS (E. E.). **Kinetics of insecticidal Action based on the Photomigration of Larvae of *Aedes aegypti* (L.).**—*Contr. Boyce Thompson Inst.* 17 no. 8 pp. 439-452, 2 graphs, 10 refs. Yonkers, N.Y., 1954.

The following is based on the authors' summary. The time required to immobilise 50 per cent. of a population of larvae of *Aedes aegypti* (L.), designated T50, was determined in concentration series of 0.01-10 parts per million [cf. R.A.E., A 42 76] for γ BHC, methoxy-DDT (methoxychlor), Dilan (a mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane), parathion, DDT, DDD (Rhothane), dieldrin, heptachlor, chlordane, Stobane (a chlorination product of terpene hydrocarbons containing about 66 per cent. chlorine), aldrin and toxaphene. In all cases the relationship between time and concentration was represented by a curve with limiting asymptotes corresponding to the minimum time required to produce 50 per cent. immobilisation at infinite concentration (τ) and the minimum concentration that could inactivate 50 per cent. of the larvae in an indefinitely long reaction period (c_0). The value for τ varied from less than one minute for γ BHC to 35.6 minutes for toxaphene and that for c_0 from 0.0006 p.p.m. for dieldrin to 0.035 p.p.m. for methoxy-DDT, corresponding in some cases to median lethal dosages obtained by the serial dilution method after incubation for 24 hours; aldrin retained its toxicity on dilution to such an extent that a value for c_0 could not be assigned to it. These data lead to the provisional conclusion that the rate of change in T50 with respect to concentration is inversely proportional to the value of T50 and also to the $(n+1)$ th power of the concentration in excess of c_0 . For many insecticides, the value of n is approximately 1; it is 1.5 for DDT and may be 2-3 for some of its analogues. Bioassay results can be obtained on all these materials in an hour or less at concentrations of 0.1-1 p.p.m.

More limited data are given for a number of other materials that are less important economically or that failed to inactivate the larvae within a reasonable time limit.

METCALF (R. L.) & MARCH (R. B.). **Further Studies on the Mode of Action of organic Thionophosphate Insecticides.**—*Ann. ent. Soc. Amer.* **46** no. 1 pp. 63-74, 2 graphs, 13 refs. Columbus, Ohio, 1953.

Though thionophosphate insecticides such as parathion and methyl-parathion do not inhibit cholinesterases *in vitro* to any appreciable extent when highly purified to eliminate S-alkyl isomerides [R.A.E., A **41** 358], it can be shown that they kill insects (and mammals) by progressive inhibition of cholinesterase of the central nervous system, and they have values for median lethal dosage approximately equivalent to those of the corresponding phosphates. It is therefore evident that they are converted to anti-cholinesterases, presumably the oxygen analogues, by an enzyme system present in insects and mammals [*cf.* **39** 308], and the experiments here described show that such a conversion readily occurs in the presence of mammalian and insect tissues under appropriate conditions. Most of the tests were with methyl-parathion, because it was easy to purify and handle, but parathion, isopropyl-parathion (O,O-diisopropyl O-p-nitrophenyl thionophosphate), malathion, O,O-diethyl S-carbamylmethyl dithiophosphate and EPN (ethyl p-nitrophenyl thionobenzene phosphonate) were also used. All were highly purified to eliminate traces of the S-alkyl isomerides.

Parathion, methyl-parathion and isopropyl-parathion all produced marked inhibition of the central nervous system of *Musca domestica* L. when topically applied in doses giving about 99 per cent. mortality. The intensity of the cholinesterase inhibition was correlated with the severity of the symptoms as previously reported for honey bees [**38** 317]. The conversion of parathion, methyl-parathion, malathion, EPN and O,O-diethyl S-carbamylmethyl dithiophosphate to anticholinesterase agents took place *in vitro* under aerobic conditions in the presence of slices of mouse liver or tissue from *Periplaneta americana* (L.). In tests with methyl-parathion and cockroach gut, the reaction was prevented by heating or homogenising the tissues and by the presence of hydrogen cyanide, sodium azide, sodium selenite, iodoacetic acid, hydroxyl amine or chloropicrin; it was most rapid between pH 8 and pH 9, and, when various tissues were tested, the highest activity was found in the fore-gut, with less in the Malpighian tubules, mid-gut, nerve cord, hind-gut and fat-body and none in the muscle or cuticle.

The conversion is presumably to the oxygen analogues, as plotting percentage inhibition of fly-brain cholinesterase against solution concentration resulted in parallel curves for the methyl-parathion metabolite and methyl-paraoxon (dimethyl p-nitrophenyl phosphate), and reversed phase paper chromatography of ether extracts of breis of parathion and methyl-parathion with cockroach gut showed the formation of compounds having values equal to those of paraoxon and methyl-paraoxon, respectively.

MILLIRON (H. E.). **Second Report on the Performance of European Corn Borer Parasites in Delaware.**—*Ann. ent. Soc. Amer.* **46** no. 1 pp. 115-128, 1 graph, 6 refs. Columbus, Ohio, 1953.

Further surveys to evaluate the activity of native and introduced parasites of *Pyrausta nubilalis* (Hb.) on maize in Delaware [*cf.* R.A.E., A **39**

329] were made in 1947-51, and the following is based on the author's summary of the results obtained. Native parasites killed only an insignificant number of larvae, the most prominent, *Pyraustomyia penitalis* (Coq.) accounting for not more than 0.1 per cent. parasitism. Of the introduced species, *Lydella stabulans griseascens* R.-D. has become firmly established throughout the State. It is the only species of importance and gave 12-31 per cent. parasitism in 1947-51. *Macrocentrus gifuensis* Ashm. is established in northern Delaware, but is of little value, as it parasitised less than 1 per cent. of all larvae collected during the survey, and *Chelonus annulipes* Wesm., *Angitia (Horogenes) punctaria* Roman and *Sympiesis (Eulophus) viridula* (Thoms.) do not appear to have become established.

GUTHRIE (F. E.). Laboratory Studies on the Toxicity of thirteen Insecticides to the Tobacco Hornworm.—*J. econ. Ent.* 47 no. 2 pp. 215-218, 1 graph, 10 refs. Menasha, Wis., 1954.

In view of inconsistent results given by insecticides against *Protoparce sexta* (Joh.) on tobacco in Florida, 13 materials were investigated in the laboratory in 1953. All were essentially pure chemicals except toxaphene, heptachlor and CS-708 [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane], which were of technical grade. Larvae collected from untreated tobacco plants were arbitrarily divided into three size-groups for treatment, and the insecticides, in dioxane solution, were applied to the dorsum of the first thoracic segment to test their contact effect or to pieces of tobacco leaf, which were the sole food provided until they were consumed, to test them as stomach poisons. After treatment, the larvae were examined and given fresh untreated tobacco leaves daily for six days. Four or more insecticide concentrations were generally used, so that dosage-mortality curves could be drawn and the median lethal dosages determined.

Endrin [*cf. R.A.E.*, A 41 268, note] was the most toxic compound tested, as both contact and stomach poison, and parathion and isodrin [*cf. loc. cit.*] were nearly as toxic. Lindane [almost pure γ BHC], malathion, dieldrin and aldrin were somewhat less effective, and toxaphene gave variable results, according to the size of the larva and action of the poison, but was generally about as effective as malathion. Heptachlor, Q-137 [ethyl-DDD (1,1-bis(p-ethylphenyl)-2,2-dichloroethane)], CS-708, DDD (TDE) and DDT were considerably less effective than the other materials tested. In general, endrin was about 2-3 times as effective as parathion and isodrin, 30 times as effective as toxaphene and malathion, 50 times as effective as CS-708 and 75 times as effective as DDD. All compounds were more toxic as stomach poisons than as contact poisons, with the exception of lindane, ethyl-DDD and possibly malathion, and toxicity decreased as larval size increased, except with toxaphene. Parathion and malathion were apparently the most rapid and DDD, ethyl-DDD, DDT, dieldrin, heptachlor and toxaphene the slowest in action.

Endrin, isodrin and parathion appeared very toxic to the larvae, but parathion has proved relatively ineffective in the field [*cf. 39* 171], probably because of its short residual action. Although DDD and toxaphene give good results against small larvae, they are much less toxic to large ones; toxaphene is considerably the more effective as a stomach poison, which probably explains its usefulness in the field. Although isodrin is less toxic than endrin, it shows promise for use, especially if endrin residues become a problem, since it is much less persistent and the residue would probably largely disappear during curing.

TURNER (N.). **Further Studies of Synergism between Nicotine and Pyrethrum.**—*J. econ. Ent.* **47** no. 2 pp. 219–224, 9 refs. Menasha, Wis., 1954.

The following is based largely on the author's summary of this account of further investigations on the joint action of nicotine and pyrethrum [cf. *R.A.E.*, A **41** 308, etc.] when applied by injection to adults of *Oncopeltus fasciatus* (Dall.). In evaluating the results, dosages of nicotine and pyrethrum giving equal mortality were considered to be equal. The data for nicotine and pyrethrum applied separately were used to determine the amount of nicotine equivalent to each dose of pyrethrum, and the observed mortalities caused by the mixtures were plotted on a graph against the sum of the nicotine and the nicotine equivalent of the pyrethrum causing them, the degree of synergism being determined by dividing the amount of nicotine required to produce 50 per cent. mortality by the nicotine equivalent of the amount of mixture that produced the same effect. The results confirmed earlier evidence of synergism between the two compounds [cf. **39** 272]. In tests in which they were used in ratios varying from 2:1 to 1:2·56, the degree of synergism varied from almost two to three and was greatest when nicotine was combined with 2·56 times as much pyrethrum as would give the same mortality. In a test of ratios ranging from 1:9 to 9:1, a 5:5 mixture produced the greatest degree of synergism and a 9:1 mixture of nicotine (as pyrethrum equivalent) and pyrethrum the least. In four out of five tests, the dosage-response curves for nicotine and pyrethrum combined, based on nicotine equivalent, were parallel with curves for the separate components.

The results of tests in which various intervals elapsed between injections of each material indicated that the toxicity of pyrethrum applied after nicotine was greater than that of nicotine after pyrethrum, the effect decreasing as the interval increased. The toxicity of nicotine after nicotine was clearly additive when the interval was six hours and decreased rapidly when it was 24 or 48 hours. The toxicity of pyrethrum after pyrethrum seemed stable regardless of the time (up to 48 hours) between treatments. The earlier conclusions that nicotine conditions the insects for pyrethrum [cf. **39** 272] is now held to be unjustified, since the results can be explained equally well on the basis of a longer period of effectiveness for nicotine.

The tests were not designed to show the reasons for the synergism between nicotine and pyrethrum, but it seems obvious that it is not the result of negative correlation of susceptibility to the two materials [cf. **37** 364], mortality being far greater than could be accounted for by this theory.

In a similar test by the same technique, there was evidence of synergism between nicotine and allethrin, but less than between nicotine and pyrethrum.

NISHIDA (T.). **Further Studies on the Treatment of Border Vegetation for Melon Fly Control.**—*J. econ. Ent.* **47** no. 2 pp. 226–229, 2 graphs, 4 refs. Menasha, Wis., 1954.

It has been shown that crops can be protected from infestation by *Dacus cucurbitae* Coq. in Hawaii by spraying the wild vegetation bordering the fields with a mist spray [cf. *R.A.E.*, A **43** 16], and an account is given of tests in which sprayers of the types now possessed by farmers were used instead of mist blowers. All were able to develop a pressure of 250 lb. per sq. in. and deliver 5 U.S. gals. spray per minute, and treatments were directed from the edge of the field into the bordering vegetation, usually

during the early morning. The insecticide tested was parathion. When it was applied to the vegetation round cucumber fields at 1 lb. 25 per cent. wettable powder per 100 U.S. gals. water, about twice a week from the time the runners appeared until harvest and once a week during harvest, and also, for comparison, to the crop itself in fields receiving no border treatment, at 0.25-0.5 lb. powder per 100 U.S. gals. at frequencies varying from twice a day to once every three days, treatment of the borders resulted in considerably lower proportions of cucumbers punctured and higher yields than treatment of the crop, which injured the plants. In a similar test on tomato, thorough spraying of border vegetation with 1 lb. parathion powder per 100 U.S. gals. about once a week reduced the percentage of fruits infested from 27 before treatment to 3 after the first two applications, with a further slight but consistent decline after the next four, whereas treatment of the crop itself with DDT at irregular intervals of about 3-10 days resulted in a slower decline in infestation or no change.

BARNES (M. M.), FLOCK (R. A.) & GARMUS (R. D.). Resistance to DDT by the Grape Leafhopper *Erythroneura variabilis* Beamer.—*J. econ. Ent.* **47** no. 2 pp. 238-242, 3 figs., 3 refs. Menasha, Wis., 1954.

Erythroneura variabilis Beamer is a major pest of grape vines in California and Arizona and the only Jassid that is numerous in the vineyards of southern California. DDT formerly gave good control in both areas [cf. *R.A.E.*, A **34** 262], but was inadequate in 1950 and ineffective by 1952 in Arizona and gave poor results in the Coachella Valley, in southern California, in 1951 and 1952. Greenhouse tests were therefore carried out on the comparative susceptibility of examples from a treated area in Arizona and from a vineyard near Verdemont, California, that had never received DDT. When caged on vines sprayed with 2 lb. 50 per cent. wettable DDT per 100 U.S. gals. and examined after 24, 48 and 72 hours, the two populations showed mortalities increasing from about 10 to 90 and from 70 to 99 per cent., respectively. A further test was carried out with these two populations and a third from a vineyard near Indio, California, having a history of DDT use and performance intermediate between them. Graphs relating mortality and time of exposure for the three populations exposed in flasks to deposits of about 10 mg. p,p'DDT per sq. ft. from acetone solution showed that they represented three strains varying significantly in susceptibility to DDT. The strain from Arizona showed no significant mortality after exposure for 48 hours, that from Indio about 15-80 per cent. in 1-24 hours and that from Verdemont 40-95 per cent. in 1-24 hours. DMC (bis(p-chlorophenyl)-methyl-carbinol), bis(p-chlorophenyl)-ethynyl-carbinol and p,p-dichlorobenzenesulphonanilide [p-chlorobenzenesulphon-p-chloroanilide], which have been shown to activate DDT against DDT-resistant house-flies [*Musca domestica* L.] [cf. B **41** 74; **43** 27] failed to activate DDT against the Arizona strain of *E. variabilis*; bis(p-chlorophenyl) chloromethane proved too toxic to the Jassids to be tested as an activator.

GRAHAM (C.) & COCHRAN (A. B.). The Periodical Cicada in Maryland in 1953.—*J. econ. Ent.* **47** no. 2 pp. 242-244, 3 refs. Menasha, Wis., 1954.

Brood X of *Magicicada septendecim* (L.) emerged in 1953 in western Maryland [cf. *R.A.E.*, A **25** 543], and the population was exceedingly

heavy in woodland and in apple orchards where trees had been present 17 years before. Most of the young apple trees in the area were planted between old trees that were removed in 1950-52, and these were severely injured unless protected by cheese cloth. However, a section of one orchard, in which the old trees were cut down in 1946, the stumps removed and the ground subsoiled between 1946 and 1948 and new trees planted in 1948, had a negligible population, whereas an adjacent one treated in the usual way was heavily infested and severely damaged in spite of five applications of TEPP (tetraethyl pyrophosphate). Since the blocks of old trees had been infested to similar degrees in 1936, the nymphs in the first section had apparently perished. Branches of old trees were also severely damaged, but the loss of fruit was believed to be less than 5 per cent. of the crop and no loss resulted from the breakage of branches immediately before or during harvest.

Emergence in orchards began on 14th May, and there were more males than females during the first week, but fewer thereafter. Oviposition on the trees was observed on 24th May, and hatching reached a peak between 25th July and 25th August. Eggs did not hatch in dead and dried limbs on the tree or in twigs that fell to the ground. Unfertilised females oviposited when caged on branches. Disking the orchards to destroy the turrets [cf. 25 544] or spraying the ground with insecticides a few days before the beginning of emergence failed to give control. Of various organic insecticides tested against the adults, only TEPP gave a high kill [cf. 38 213, etc.]; practically complete mortality was given in six hours by treatment with 6-8 oz. 40 per cent. TEPP per 100 U.S. gals. and in a longer time by treatment with 8-10 oz. 20 per cent. TEPP.

ARANT (F. S.). **Control of Thrips and Leafhopper on Peanuts.**—*J. econ. Ent.* 47 no. 2 pp. 257-263, 10 refs. Menasha, Wis., 1954.

The following is based on the author's summary. Replicated small-plot and field-scale experiments were carried out in Alabama in 1946-50 on the control of *Frankliniella fusca* (Hinds) and *Empoasca fabae* (Harris) on groundnuts. Dusts containing 2-5 per cent. DDT, 10-20 per cent. toxaphene or 2 per cent. γ BHC, applied at the rate of 20 lb. per acre, were highly effective in reducing the population of the thrips and one of 20 per cent. sabadilla was moderately effective, but 1 per cent. rotenone and 2 per cent. nicotine were ineffective. The DDT and toxaphene dusts were also effective against *Empoasca*, 3 per cent. p,p'-methoxy-DDT (methoxy-chlor), 20 per cent. sabadilla and dusting sulphur were less effective, and 2 per cent. γ BHC, 5 per cent. chlordane, 1 per cent. rotenone and 2 per cent. nicotine were ineffective.

There were no consistent gains in yield of Spanish or runner groundnuts from two applications of 10 per cent. toxaphene or 5 per cent. DDT, the first made when the plants were seedlings and the second ten days later, for thrips control, but in both small-plot and field experiments, groundnuts receiving four applications of 2-2.5 per cent. DDT or 10-20 per cent. toxaphene at 20 lb. per acre during July and August against *Empoasca* gave significantly greater yields than untreated plants. When the insecticide was used with a fungicidal mixture of 3.4 per cent. copper and at least 65 per cent. sulphur, the yields were usually significantly greater than when it was applied without the fungicide.

The treatment recommended is dusting with 2.5 per cent. DDT or 10 per cent. toxaphene at 20 lb. per acre in the fungicide mixture four times at intervals of 7-10 days, beginning at about the time of the last cultivation

in mid-July on runner groundnuts and 2-3 weeks earlier on Spanish groundnuts.

KERR jr. (T. W.). **Control of Willow Flea Weevil, Rhododendron Lace Bug and Red-headed Pine Sawfly.**—*J. econ. Ent.* **47** no. 2 pp. 263-266, 9 refs. Menasha, Wis., 1954.

The following is substantially the author's summary of this account of further investigations, carried out in 1953, on the control of pests of ornamental trees and shrubs [cf. *R.A.E.*, A **40** 227]. Both DDT and p,p'methoxy-DDT (methoxychlor) proved effective in sprays against *Rhynchaenus rufipes* (Lec.) on *Salix pentandra* and *S. babylonica* when applied four times at 1 lb. 50 per cent. wettable powder per 100 U.S. gals. water 5, 20, 39 and 53 days after adult emergence from hibernation had begun (on 29th April). Two applications at twice the strength on the first two dates did not prevent oviposition and subsequent larval attack on the leaves, the overwintered adults persisting until late July, and delaying the first of two applications until 16 days after the appearance of the adults also failed to prevent substantial larval mining.

The same sprays and one containing 1 lb. 25 per cent. lindane [almost pure γ BHC] per 100 U.S. gals. water were effective against *Stephanitis rhododendri* Horv. on rhododendron, one application in early June, when the overwintered eggs were hatching, controlling the nymphs and preventing reinfestation by the following generation, and the DDT and methoxy-DDT sprays and one of 1 lb. 25 per cent. malathion per 100 U.S. gals. controlled larvae of *Neodiprion lecontei* (Fitch) in the third, fourth and fifth instars on *Pinus sylvestris* when applied in early July.

CLARK (E. C.) & THOMPSON (C. G.). **The possible Use of Microorganisms in the Control of the Great Basin Tent Caterpillar.**—*J. econ. Ent.* **47** no. 2 pp. 268-272, 2 graphs, 12 refs. Menasha, Wis., 1954.

Bitterbrush (*Purshia tridentata*) is the most important forage plant on the rangelands in California east of the Sierra Nevada and is heavily grazed by deer, sheep and cattle. It is frequently defoliated by *Malacosoma fragile* (Stretch), and though it then produces new growth in the same season, this is often grazed by the animals. A repetition of the process in successive years may result in the death of the plants and replacement by less desirable vegetation.

Species of *Malacosoma* are known to be susceptible to diseases, and a polyhedrosis virus that was isolated from *M. fragile* by H. B. Wasser in California was found to attack *M. fragile*, *M. disstria* Hb. and *M. pluviale* (Dyar) equally readily. In 1950-51, high populations of *M. fragile* developed on *Ceanothus cordulatus* in Fresno County, California, and large proportions of the larvae were destroyed by polyhedrosis in 1952. A stock of the virus material was obtained by spraying larvae of *M. californicum* (Pack.) in an abandoned orchard, collecting the infected larvae a week later, and subsequently preparing a suspension from the dead and dying individuals. This was diluted to contain various concentrations of polyhedra [cf. *R.A.E.*, A **38** 201] and applied as a spray in June 1952 to small plots of *P. tridentata* infested by *M. fragile* in Nevada County. Dying caterpillars were subsequently numerous in all treated plots. Mortality was found to be due to polyhedrosis and was estimated at 80 per cent. In 1953, treatment of plots with suspensions of 13, 5 or 0.5 million polyhedra per ml. at 10 U.S. gals. per acre on 24th June caused a reduction in population that was evident

after eight days and resulted in 9, 21 and 12 larvae per tent after 13–21 days, as compared with 84 after no treatment. On treated plots, dead larvae were observed in almost every tent and polyhedra were present in nearly all of them. In plots treated with 6, 3·1 and 1·5 million polyhedra per ml. at 10 U.S. gals. per acre on 1st July, mortality due to virus infection reduced populations to 46, 69 and 57 per cent. of those in untreated plots in nine days and to 6, 18 and 32 per cent. in 14. A predacious beetle of the genus *Calosoma* caused considerable reductions in population in both treated and untreated plots. Larvae that survived treatment with a spray of 13 million polyhedra per ml. for 45 days all succumbed to the disease when fed on leaves of *P. tridentata* that had been dipped in a heavy suspension of polyhedra in the laboratory, showing that if immunity was responsible for their survival in the field, it was not absolute or long-lasting. Survival may, however, have been due to lack of uniformity in the original field application.

MACCOLLUM (G. B.). Tolerance of Cucumbers to component Compounds of technical DDT.—*J. econ. Ent.* **47** no. 2 pp. 272–275, 9 refs. Menasha, Wis., 1954.

DDT has been found to injure some cucurbits in the United States [*cf. R.A.E.*, A **37** 416], and even the use of DDT of aerosol grade did not prevent all phytotoxicity on Niagara cucumbers in tests in New York. The addition of activated charcoal (3:1) to DDT in a 2 per cent. DDT dust, applied weekly five times from the appearance of the first true leaves, greatly reduced the symptoms, but no further reduction was given by increasing the proportion of charcoal. Water-soluble fractions of technical DDT were shown to have no deterrent effect on the growth of the plants, whereas the insoluble fraction caused severe stunting, and tests were therefore made of the five major constituents of technical DDT. These with (in brackets) the percentage in which they occur in the technical compound are p,p'DDT (72·7), o,p'DDT (19), p,p'DDD (4), 2-trichloro-1-o-chlorophenyl-ethyl p-chlorobenzenesulphonate (1·85) and dichlorodiphenyl sulphone (0·6).

The technical compound itself and a dehydrohalogenated DDT (DDE [1,1-bis(p-chlorophenyl)-2,2-dichloroethylene]) were also included. All the materials were applied to the cucumber plants in emulsion sprays, and measurement of the weight of the plants and their length from the growing point to the stem at soil level 25 days after treatment showed that technical DDT caused very severe injury, reducing growth significantly more than any other material. o,p'DDT retarded growth almost as much as p,p'DDT, and DDE reduced it significantly, indicating that dehydrohalogenation of DDT does not alter its phytotoxic characteristics. The other compounds appeared to have no injurious effect. It is concluded that the phytotoxicity of technical DDT is primarily associated with the p,p'- and o,p'-isomers.

FROST (S. W.). Response of Insects to black and white Light.—*J. econ. Ent.* **47** no. 2 pp. 275–278, 1 ref. Menasha, Wis., 1954.

In further investigations in Pennsylvania in 1953 on the response of insects to ultraviolet and visible light [*cf. R.A.E.*, A **41** 370], the 100-watt mercury-vapour lamp with the red-purple filter [*cf. loc. cit.*] was compared with a white frosted filament lamp of 10–100 watts, both operated at a height of eight feet above ground during darkness. The intensities in foot-candles of the ultraviolet lamp and the 10-watt white lamp were approximately the same. The lamps were hung 100 ft. apart with intervening foliage, so that one light was not visible from the other, from 11th May

to 16th July, and 3 ft. apart from 17th July to 2nd September, and it was found that larger proportional catches occurred when lights of equal intensity were operated separately.

It was evident from the results, which are shown in a table, that more insects are generally attracted to ultraviolet than to white light when the intensities are approximately the same, and the greater attraction of the former was even more pronounced when ultraviolet and white lights of equal intensity were operated together. Exceptions occurred chiefly in the Mirids and Chrysopids, which apparently responded more freely to white light.

ALLEN (H. W.). **Propagation of *Horogenes molestae*, an Asiatic Parasite of the Oriental Fruit Moth, on the Potato Tuberworm.**—*J. econ. Ent.* 47 no. 2 pp. 278-281, 3 refs. Menasha, Wis., 1954.

Although *Angitia (Horogenes) molestae* (Uch.) did not become established when it was imported and released on a large scale in the United States in 1932-37, it showed a far greater ability to attack *Cydia (Grapholitha) molesta* (Busck) than any of the other 23 foreign parasites liberated against the moth, with an initial high rate of increase in many places. In view of this and of the successful propagation of *Macrocentrus aencylivorus* Rohw. on *Gnorimoschema operculella* (Zell.) in the laboratory [cf. *R.A.E.*, A 39 279], *Angitia* was imported again in 1949, from Japan, and attempts were made to breed it for mass liberation. When *Gnorimoschema* larvae in potato tubers were exposed to *Angitia* females, there was very little oviposition, but the few parasite adults that emerged appeared normal. It was then found that when halves of green apples pinned to halves of potato tubers along the cut surfaces were stocked with a mixture of eggs of *Cydia* and *Gnorimoschema*, many of the newly hatched larvae of both species entered at the junction of the cut surfaces and remained mixed in this area for a few days. *Angitia* females immediately attacked the larvae along the junction and parasitised *Gnorimoschema* at least as freely as *Cydia*. Use of this host mixture resulted in 7.1 per cent. parasitism of *Gnorimoschema*, but when the combination of apple and potato was stocked with *Gnorimoschema* alone, parasitism was only 1.3 per cent. During the winter of 1949-50, small-scale breeding was continued through several generations on the mixture of hosts, nearly all the parasites issuing from *Gnorimoschema* larvae. To reduce labour, tubers infested with *Gnorimoschema* were subsequently sprayed with an ether extract of *Cydia* larvae or rolled in a mixture of ethanol and finely-ground apple that had been heavily infested with *C. molesta*, and this also resulted in a satisfactory rate of production. In a series of tests made in the following August, after about 11 generations had been stimulated to accept *Gnorimoschema* as host, parasitism of *Gnorimoschema* larvae in tubers that had not been treated with any attractant was about as high as that of any of the samples treated with attractants. Breeding with attractants was continued provisionally, but similar results were obtained in the summer of 1951, indicating that a strain adapted to the new host had been segregated, and the parasite was then propagated continuously on *Gnorimoschema* without attractants. The method adopted, in which infested potatoes are exposed for several days to parasite females and then kept in bags for rearing to the cocoon stage in strongly circulated air is essentially the same as that used in propagating *M. aencylivorus* [cf. *loc. cit.*].

In the routine mass rearing on *Gnorimoschema* larvae without attractants in 1952, the rate of reproduction was 6.9 females per breeding female of *Angitia*, and 131 parasites, of which 42 were females, were produced per

pound of tubers. This rate was 24 times as great as that obtained in the first attempt in 1949.

GERHARDT (P. D.) & LINDGREN (D. L.). **Penetration of various Packaging Films by common Stored-product Insects.**—*J. econ. Ent.* 47 no. 2 pp. 282-287, 2 figs., 1 ref. Menasha, Wis., 1954.

The following is based on the authors' introduction and summary. Transparent wrapping materials are being used increasingly in the packing of food products, and investigations on the resistance of some of them to insects that commonly attack stored products were begun in California in 1952. Tests were made by packing walnut meats in sealed bags of the different materials and exposing the packages to large numbers of the experimental insects for several weeks or by confining 50 adults of a given species in a plastic cup inverted over another containing an appropriate food supply and separated from it by a flat piece of the test material; 14 different packing films and 11 species of insects, comprising *Calandra (Sitophilus) granaria* (L.), *C. (S.) oryzae* (L.), *Rhizopertha dominica* (F.), *Tenebroides mauritanicus* (L.), *Oryzaephilus surinamensis* (L.), *Tribolium confusum* Duv., *Sitodrepa (Stegobium) panicea* (L.), *Trogoderma sternale* Jayne, *Ephestia kuehniella* Zell., *Plodia interpunctella* (Hb.) and *Blattella germanica* (L.) were used.

Non-transparent laminated film containing aluminium foil as one of the laminae was relatively resistant to penetration but not proof against it. Of the transparent laminated films tested, one consisting of saran 0.0015 inch thick and pliofilm 0.0012 inch thick was the most resistant. Cellophane films, single and laminated, were readily penetrated by most of the insects tested. The resistance of polyethylene film varied directly with its thickness; it was rather more resistant at 0.0015 inch than cellophane of about the same thickness, whereas at 0.004 inch it was penetrated only by *R. dominica* and *Tenebroides mauritanicus*. These appeared to be the best able, and *O. surinamensis* the least able to penetrate the materials tested. [cf. *R.A.E.*, A 32 266].

STAFFORD (E. M.). **Use of Parathion to control Olive Scale.**—*J. econ. Ent.* 47 no. 2 pp. 287-295, 3 refs. Menasha, Wis., 1954.

The results are given of a further four years' investigations on the control of *Parlatoria oleae* (Colv.) on olives and deciduous fruits in California [cf. *R.A.E.*, A 38 284]. In the central valley, the adult females of this Coccid overwinter and oviposit on olive in late March. Hatching of the first generation begins in early May and that of the second towards the end of July. The developmental stages overlap considerably in the second generation but little in the first; and there are few if any scales of a third generation. On deciduous fruit trees, oviposition begins in late February or early March, and hatching reaches a maximum in April, development in spring thus occurring about three weeks earlier than on olive.

Comparison of several winter spray treatments on two varieties of olive showed that the addition of wettable parathion to oil sprays enhanced their effectiveness and that this increased with both oil and parathion concentration, sprays of 2.5 U.S. gals. oil and 1 lb. 15 per cent. parathion per 100 U.S. gals. giving 58-69 per cent. uninfested fruits of one variety at harvest. Light, light-medium and medium grade summer oils were equally effective and more so than an experimental summer oil of very light grade. When similar sprays were applied on different dates between mid-February and late July, treatment in early June gave the best results (about 90 per

cent. uninfested olives). Sprays applied in late May would probably be almost as effective, but would be a danger to bees, and those applied before flowering were less effective than those applied immediately after it. Treatment was useless in early July, probably because only mature females, which are difficult to kill, are then present, but fairly effective in late July, when a large proportion of the population was immature. When treatments were applied in early June, a very light grade of spray oil increased the effectiveness of parathion less than light, light-medium or medium oils, and kerosene was of no value as a substitute for the latter. DDT, DDD (TDE), toxaphene, chlordane, aldrin and dieldrin, alone or with oil, gave poor control. EPN [ethyl p-nitrophenyl thionobenzene phosphonate], Metacide [containing methyl-parathion and a smaller quantity of parathion], malathion and sulfatepp [tetraethyl dithiopyrophosphate] were less effective than parathion, though they were improved by the addition of oil. Malathion damaged the olives. Sprays of 1.5 lb. 25 per cent. wettable parathion per 100 U.S. gals. with a proprietary deposit builder gave consistently good control, and were about as effective as the mixtures of parathion and oil.

Parathion was found to have considerable fumigant effect, but control was inadequate on olive twigs covered during the application of the spray and then uncovered. In tests with a blower-sprayer, control was inferior when less spray was used per acre, even though the quantity of parathion and oil was not reduced. Treatment by hand was more effective, but as considerable improvements have been made in blower equipment since the tests were carried out, it may give better results in future. A 2 per cent. parathion dust gave good control when applied in late July and also when applied twice in May if infestation was not too high, but would be dangerous to bees at that time. Late May (after flowering) or early June was the best time of application. Sulphur increased the effectiveness of the dust, but also increased the danger of plant injury. The use of parathion on olives later than the beginning of August has been forbidden, as it may enter the olive oil, and tests showed that this precaution was justified.

The spray most widely used by growers contains 1 lb. 25 per cent. parathion and 1.5 U.S. gals. light or light-medium summer-oil emulsion per 100 U.S. gals. water and is applied in early June, and this increased the percentage of uninfested olives from 61 in 1949 to more than 99.9 in 1952 in one orchard in which it was applied commercially for four successive years. Some growers prefer dusts, and two applications of 2 per cent. parathion at 100 lb. per acre by aeroplane may be cheaper than spraying if the trees are large; in general, dusting has been less effective than spraying in commercial operations.

On peach, insecticides against *P. oleae* can be added to the pre-bloom fungicide spray. Some varieties are injured by high concentrations of dormant oil, but the addition of 2 lb. 25 per cent. wettable parathion permitted a reduction of dormant oil emulsion from 4-5 to 3 U.S. gals. per 100 U.S. gals. spray while increasing control. The addition of a fixed copper fungicide did not reduce effectiveness, and this treatment also controlled overwintering eggs of spider mites and larvae of the peach twig borer [*Anarsia lineatella* Zell.]. Sprays applied in spring were more effective than dormant sprays, but the use of parathion in spring interfered with fruit thinning, since fruits sprayed with parathion should not be handled. A spray of EPN and oil, applied in spring, was as effective as one of parathion and oil. In similar sprays on plum, Metacide caused scars on many fruits, where the spray dried slowly, and injured the leaves. Emulsifiable malathion and parathion both marked the young plums, apparently owing to the effect of the emulsifying agent.

BARTHOLOMAI (C. W.). **Predatism of European Corn Borer Eggs by Arthropods.**—*J. econ. Ent.* **47** no. 2 pp. 295–299, 8 refs. Menasha, Wis., 1954.

The following is based on the author's summary. In observations in Indiana in 1946 on the value of predators in destroying the eggs of the European corn borer [*Pyrausta nubilalis* (Hb.)], two strains of maize that were attractive to the moths and two that were unattractive were sown in plots on four dates, two for observations on the first generation and two for the second. Records of eggs and counts of all predators present were made three times a week. The results showed that 1,166 of the 10,070 eggs laid during the season were destroyed by predators, 785 of 9,061 being destroyed in the first generation and 381 of 1,009 in the second. The total numbers of predators observed were 212 and 1,445, respectively. It thus appears that in years in which there is a large second generation of *P. nubilalis*, predators may destroy a considerable proportion of the eggs. The only predators actually seen attacking the eggs were mites and *Orius insidiosus* (Say). *Ceratomegilla fuscilabris* (Muls.) was seen doing so on adjacent maize and was the commonest predator in the experimental plots.

CONNOLA (D. P.), YOPS (C. J.) & SMITH (W. E.). **European Pine Shoot Moth Control Tests.**—*J. econ. Ent.* **47** no. 2 pp. 299–302, 5 refs. Menasha, Wis., 1954.

In view of damage by *Rhyacionia buoliana* (Schiff.) to red pine [*Pinus resinosa*] in reforestation areas in south-central New York, tests were made in 1951 and 1952 on the control of this moth by sprays applied from an aeroplane. In 1951, an emulsion spray containing 1 lb. DDT per U.S. gal., applied at 2, 3 or 4 U.S. gals. per acre on 11th or 12th July, when most of the adults had emerged and pupae, eggs and newly hatched larvae were also present, resulted in 39, 47 and 12 per cent. damaged tips in October, as compared with 39 per cent. on untreated trees.

In 1952, 4 lb. DDT in 4 U.S. gals. spray applied on 10th or 11th July, when conditions resembled those on the same dates in 1951, caused no appreciable reduction in damage. No satisfactory explanation was found for the difference in results in the two years, though there appeared to be a greater percentage of adult emergence in 1952, and it is feared that if, as is possible, success can be obtained only through a fortunate combination of favourable conditions, most of which are unpredictable and none of which can be controlled, the application of DDT by aeroplane to control *R. buoliana* is less promising than first appeared.

BOLLEN (W. B.), MORRISON (H. E.) & CROWELL (H. H.). **Effect of Field Treatments of Insecticides on Numbers of Bacteria, *Streptomyces*, and Molds in the Soil.**—*J. econ. Ent.* **47** no. 2 pp. 302–306, 7 refs. Menasha, Wis., 1954.

Preliminary investigations in Oregon in 1947 showed that heavy soil applications of some insecticides were toxic to many plants [cf. *R.A.E.*, A **37** 417–418], and observations in the following year showed that the adverse effects were still continuing. In order to study the effect of insecticides on soil micro-organisms in the field, samples of different soils were taken from plots to which various materials had been applied, and counts of bacteria and moulds were made from cultures in the laboratory.

In most cases, wettable powders containing 20–25 per cent. active compound were diluted with sand, applied with a small fertiliser applicator to

give the required rates and incorporated into the soil by rotary tilling [*cf.* 41 202]. BHC at rates of 0.25–20 lb. γ isomer per acre to a depth of 6.7 ins. caused slight but inconclusive reductions in moulds in silty clay loam, clay loam or fine sandy loam soils and had relatively little effect on the total numbers of bacteria; at 20 lb. it strongly depressed the percentage of *Streptomyces*. This group is important because of its ability to attack lignins and celluloses, and was little affected by any other treatment. Chlordane at 5–20 lb. per acre in fine sandy loam and DDT at 10–20 lb. in clay loam decreased the numbers of moulds but had little effect on bacteria. At 10 lb. per acre, in silty clay loam, parathion, γ BHC and DDT depressed total mould counts slightly and aldrin considerably, EPN [ethyl p-nitro-phenyl thionobenzene-phosphonate] had little effect, and dieldrin, chlordane and toxaphene increased them. There was no significant difference in effect on different moulds; *Penicillium* predominated, and the mucors and *Aspergillus* occurred in typically limited ranges. Differences in the bacterial counts and *Streptomyces* percentages were too small to be significant.

D-D fumigant [a mixture of 1,3-dichloropropene and 1,2-dichloropropane], applied at 33–48 U.S. gals. per acre to silty clay loam in spring, considerably decreased the numbers of moulds and bacteria; the addition of ammonia to it lessened the reduction of bacteria and stimulated the moulds. D-D, alone or with ammonia, lowered the percentage of *Penicillium* by about half and greatly increased that of *Aspergillus*. Applications of D-D in summer also caused a considerable decrease in moulds, though the numbers were much higher than in spring.

On peat soil, chlordane and toxaphene were either applied in wettable powders with sand or sprayed in water suspension, with no differences in results. Numbers of moulds and proportions of *Penicillium* were significantly increased by toxaphene at 10 lb. per acre, but unaffected by it at 20 lb., and chlordane at 4–6 lb. increased the proportion of *Penicillium* without significantly altering the total mould count. No treatment caused significant changes in total numbers of bacteria, but chlordane at 6 lb. increased the proportion of *Streptomyces*.

When samples of silty clay loam treated with D-D and of peat treated with chlordane or toxaphene were kept in air-tight storage for 5–10 months at room temperature, the effects of the compounds were not much altered with time, except that chlordane appeared to inhibit bacteria on storage.

BOLLEN (W. B.), MORRISON (H. E.) & CROWELL (H. H.). Effect of Field and Laboratory Treatments with BHC and DDT on Nitrogen Transformations and Soil Respiration.—*J. econ. Ent.* 47 no. 2 pp. 307–312, 6 refs. Menasha, Wis., 1954.

The following is substantially the authors' summary of laboratory studies in Oregon on the influence of insecticides on soil micro-organisms [*cf.* preceding abstract]. The α , β , γ and δ isomers of BHC added to a clay adobe soil at 1,000 parts per million in the laboratory produced different effects on the numbers of bacteria and moulds that developed on incubation and also on ammonification and nitrification. The γ isomer considerably increased the bacterial population, although *Streptomyces* was decreased; the other isomers gave smaller increases. When mould development was favoured by adding dextrose to the soil, the γ and δ isomers increased the numbers, whereas the α and β isomers decreased them. In the absence of dextrose, when the moulds were less abundant, all but the α isomer were inhibiting. The γ and δ isomers increased ammonification of peptone; the other isomers had no effect. Nitrification of ammonium sulphate was increased by the β and γ isomers, but in field-treated soil the subsequent formation of nitrates

in the laboratory was decreased when BHC had been added to the rate of 275 lb. per acre. Carbon-dioxide evolution and dextrose decomposition were the same in soil that had been treated with BHC or DDT in the field as in untreated soil.

The γ isomer appeared to be quantitatively and qualitatively more effective than the other isomers of BHC in producing response by soil micro-organisms, but the stimulations and inhibitions observed are considered to be insufficiently intensive to have a material effect on soil fertility.

APP (B. A.). Insecticide Tests to control the Alfalfa Weevil and the Meadow Spittlebug in Maryland.—*J. econ. Ent.* **47** no. 2 pp. 313-316, 1 ref. Menasha, Wis., 1954.

In 1953, larvae of *Hypera variabilis* (Hbst.) (*postica* (Gylh.)) caused severe damage to lucerne in Maryland on the Eastern Shore and in the area north of Baltimore [*cf. R.A.E.*, A **41** 283], and this, together with injury due to nymphs of *Philaenus leucophthalmus* (L.), constituted a serious problem to growers. Adult weevils were first found on 24th March, and were most abundant from late April to early July, relatively rare from mid-July to early October and abundant again in late October and early November; they were active on mild days until 8th December. Eggs were found in the field from 8th April to 3rd June and from 2nd November to 8th December, larvae were present from 14th April to 8th December, abundant during the first half of May and scarce at other times, and pupae occurred throughout most of May; the finding of empty cocoons on 12th May indicated that adult emergence had begun.

In several preliminary tests with insecticides in emulsion sprays applied once at about 10 U.S. gals. per acre in late March or early April, dieldrin and heptachlor at about 0.25 lb. per acre gave promising control of the larvae of *H. variabilis* on the first crop, whereas endrin at the same rate and p,p'methoxy-DDT (methoxychlor) at about 1-2 lb. were rather less and toxaphene at about 1.5-2 lb. much less satisfactory. None of the insecticides was very effective against larvae that hatched 2-3 weeks after spraying, but the most promising still gave considerable protection. When cutting was delayed for more than two weeks, damage resulted from increased larval populations even in plots treated with heptachlor or dieldrin, and it is concluded that for best results the crop should be cut promptly. Additional data are needed to assess the effect of time of application in relation to cutting date on residues at harvest.

All insecticides gave effective control of *Philaenus*, indicating that a single application may be used to control both this pest and the weevil. The spraying of lucerne stubble with about 0.5 lb. heptachlor, 0.25 lb. endrin or dieldrin or 1.64 lb. ethyl-DDD (Q-137 [1,1-bis(p-ethylphenyl)-2,2-dichloroethane]) per acre after the removal of the first hay crop, for the control of *H. variabilis*, hastened regrowth.

LIEBERMAN (F. V.), BOHART (G. E.), KNOWLTON (G. F.) & NYE (W. P.). Additional Studies on the Effect of Field Applications of Insecticides on Honey Bees.—*J. econ. Ent.* **47** no. 2 pp. 316-320, 3 refs. Menasha, Wis., 1954.

In further field tests of the effect on honey bees of applying organic insecticides to flowering lucerne, made near Logan, Utah, in 1950, 1952 and 1953 [*cf. R.A.E.*, A **38** 411], about 4-5 acres of a seed crop were sprayed or dusted before 7 a.m. or, in a few cases, after 7 p.m., and the

effect of each application on the field force of a small apiary at the edge of the field was measured by counting the dead bees at the hives and in the treated area. In each test, the dosage was one considered adequate for controlling pests on the lucerne, and 10 per cent. mortality of the bees was arbitrarily taken as the maximum permissible. Amounts of insecticide are given per acre.

In July and August 1950, morning applications of about 1.5 lb. toxaphene in spray or dust, 0.5 lb. DDT in a spray and 1 lb. chlordane in a dust killed few bees, 0.5 lb. DDT in a dust killed 10 per cent., and 1 lb. chlordane in a spray killed 8-19 per cent. In August 1952, morning applications of 2 oz. aldrin, 4 oz. heptachlor, 10 oz. malathion or 6 oz. TEPP [tetraethyl pyrophosphate] in sprays killed 10-63 per cent. of the field force, but an evening application of 6 oz. TEPP killed only 6 per cent. Malathion continued to kill the bees for at least four days. Morning applications of 6 oz. Systox [diethyl 2-(ethylmercapto)ethyl thiophosphate], 4 oz. endrin, 2 oz. aldrin or 1 oz. dieldrin in sprays in August 1953 killed 1, 13, 22 and 36 per cent. of the field force, respectively; it is considered that endrin should be further tested at a slightly lower dosage or in evening applications. When the numbers of bees dying at the hives and in the field during the three years were compared, the percentage of the total kill that occurred in the field varied from 0 for toxaphene to 100 for DDT; it is therefore necessary to make field counts as well as hive counts to evaluate the toxicity to bees of field treatments. Most of the materials tested caused many bees to stay away from the field for at least a few hours after initial contact.

ACREE jr. (F.). **The Chromatography of Gyptol and Gyptyl Ester.**—*J. econ. Ent.* **47** no. 2 pp. 321-326, 8 graphs, 12 refs. Menasha, Wis., 1954.

Attempts to isolate pure gyptol, the sex attractant extracted from unfertilised females of *Lymantria (Porthetria) dispar* (L.) [cf. *R.A.E.*, A **41** 360; **42** 165], and to characterise it, beyond the fact that it is an alcohol, have proved unsuccessful, but it has been shown by chromatography that an active fraction of crude gyptol azoate [**42** 165] could be resolved into three active fractions of azoates and separated from an active fraction at first presumed to consist of free gyptol but now considered to be the natural ester. The further chromatographic studies described showed that the effectiveness of the attractant can be attributed to two or possibly three fatty esters derived from at least two different alcohols (gyptols). The starting material for the work was the unsaponifiable fraction prepared from a benzene extractive of female moths [cf. **33** 239] in 1947, and it is considered that the work should be repeated with fresh starting material.

GYRISCO (G. G.), MUKA (A. A.), HOPKINS (L.) & NEUNZIG (H. H.). **Insecticide Concentrations and Timing of Applications for Control of the Clover Root Borer.**—*J. econ. Ent.* **47** no. 2 pp. 327-331, 6 refs. Menasha, Wis., 1954.

The following is based on the authors' introduction and summary. Although earlier work in New York had shown that several organic insecticides, applied in dusts, give excellent control of *Hylastes (Hylastinus) obscurus* (Marsh.) on clover [cf. *R.A.E.*, A **38** 431], information was lacking on the minimum effective concentrations, on practical methods of timing applications and on the use of the materials in sprays. Tests were therefore carried out on red clover in 1950-53 in which various insecticides were compared in dusts and sprays applied in spring or autumn. The

results showed that although aldrin, dieldrin or heptachlor at 0.5 lb. per acre in dusts gave satisfactory control, based on counts of all stages, they were more consistently effective at 1 lb. per acre. BHC, lindane [almost pure γ BHC], isodrin and chlordane gave good control at 1 lb. per acre in dusts, but endrin, toxaphene, p,p'methoxy-DDT (methoxychlor), DDD (TDE), parathion and NPD (tetra-n-propyl dithionopyrophosphate) were unsatisfactory at this and higher dosages. In preliminary tests, aldrin and lindane gave good control at 1 lb. per acre in emulsion sprays, but sprays were in general less reliable than dusts; at least 20 U.S. gals. was required per acre for the best results. Spring and autumn applications were about equally effective, with no appreciable residue on the hay at harvest from either, but spring treatments may be more practicable as autumn is often the busiest season of the farming year. They should be made as late as possible, before the flight of the adults, so that the maximum amount of toxicant will be present round the crowns of the plants when the migrating beetles arrive.

HORNSTEIN (I.), SULLIVAN (W. N.), TSAO (Ching-hsi) & YEOMANS (A. H.).

The Persistence of Lindane-Chlorinated Terphenyl Residues on outdoor Foliage.—*J. econ. Ent.* **47** no. 2 pp. 332-335, 5 refs. Menasha, Wis., 1954.

Laboratory tests have shown that mixtures of lindane [almost pure γ BHC] and chlorinated terphenyl (Aroclor 5460) leave film-like residues in which the effective life of the lindane is prolonged by a reduction of its vapour pressure and of the surface available for evaporation and by gradual migration of the lindane to the surface of the film [*cf. R.A.E.*, B **42** 131, etc.]. The preparation of sprays suitable for application to plants is discussed, and details are given of 16 formulations comprising lindane with the chlorinated terphenyl in suspensions and with and without it in solutions and emulsions of solutions, and of tests in which they were sprayed in various ways on the foliage of plants including conifers, broad-leaved trees and grass, and house-flies (*Musca domestica* L.) were exposed at intervals to the residues. Some of the deposits were also tested for resistance to washing with water. It is concluded from the results that combinations of lindane and the chlorinated terphenyl are more persistent on outdoor foliage than lindane alone. They should not, however, be applied in oil solutions, which tend to penetrate the leaf surface, or in stable emulsions, which are easily removed by washing. Effective applications of emulsions containing low-boiling ketones as the oil phase can be made if the water phase contains a fairly high concentration of a water-soluble material, such as a high-conversion maize syrup, and if either the emulsifying agent readily decomposes after application or an unstable emulsion is used.

KULASH (W. M.) & MONROE (R. J.). **Laboratory Tests for Control of Wireworms.**—*J. econ. Ent.* **47** no. 2 pp. 341-345, 1 ref. Menasha, Wis., 1954.

In further laboratory tests of organic compounds for the protection of maize or oats against attack by the larvae of *Melanotus communis* (Gylh.) in North Carolina [*cf. R.A.E.*, A **42** 10], various materials were used in seed coatings, mixed with the soil before sowing or applied with fertiliser at the time of sowing. Effectiveness was measured by the degree of wireworm injury to the plants and the kill of wireworms 8-9 days after sowing, when the plants were 6-8 ins. high.

When used to coat maize seed, 0.566-4.56 gm. 25 per cent. aldrin or dieldrin, 2.28-4.56 gm. 25 per cent. heptachlor, 2.3 gm. 25 per cent. lindane [almost pure γ BHC], 0.614 gm. 75 per cent. lindane and 4.56 gm. 15 per cent. parathion or 50 per cent. chlordane per 450 gm. seed prevented all plant damage and killed 17-75 per cent. of the wireworms, whereas 4.56 gm. 50 or 75 per cent. DDT, 50 per cent. 1,1-bis(p-chlorophenyl)-2-nitropropane, 1,1-bis(p-chlorophenyl)-2-nitrobutane or ethyl-DDD, 20 per cent. pentachloronitrobenzene or inert clay did not afford satisfactory protection and killed few or no wireworms. Increasing the dosage of insecticide did not increase wireworm kill.

In soil treatments with 1 lb. aldrin, 2 lb. heptachlor or lindane, 5-10 lb. parathion or chlordane or 25 lb. DDT per acre, mixed with the soil as dusts before sowing, only heptachlor gave satisfactory kill and plant protection. When mixed with fertiliser and applied in the same way, 500 lb. potassium ethyl xanthate with 500 or 1,000 lb. superphosphate per acre killed 10-60 per cent. of the wireworms and prevented plant damage, with or without the addition of 250 lb. sulphur, whereas 50 lb. ethyl-DDD or 20-100 lb. pentachloronitrobenzene per acre gave no kill and poor protection. In tests of insecticides applied as sprays to the soil before sowing, heptachlor and lindane at 2 lb. per acre gave complete kill and complete protection of oats, dieldrin and aldrin at 2 lb. and chlordane at 4 lb. gave 33-100 per cent. kill and some protection, and endrin at 2 lb. and demeton [diethyl 2-(ethyl-mercapto)ethyl thiophosphate] at 0.25 lb. per acre poor kill and little or no protection. Potassium ethyl xanthate appeared to cause slight yellowing of the foliage, but plants were unaffected by the other soil treatments.

When the insecticides were applied with fertiliser to the surface of the soil and maize seeds were placed on the surface and subsequently covered with untreated soil, heptachlor at 2 and 5 lb. per acre resulted in 84 and 76 per cent. kill and complete protection, aldrin at 1, 2 and 4 lb. in 63, 52 and 54 per cent. kill and 12, 24 and 28 per cent. plants injured, and parathion at 20 lb. and lindane at 4 lb. in 68 and 64 per cent. kill and 16 and 28 per cent. plants injured, respectively, whereas 1 lb. heptachlor, 5-10 lb. parathion, 2 lb. lindane, 1-4 lb. dieldrin, 5-10 lb. chlordane and 25 lb. DDT proved unsatisfactory.

DOMINICK (C. B.). Insecticide Tests for Tobacco Flea Beetle Control.—
J. econ. Ent. **47** no. 2 pp. 346-349, 2 refs. Menasha, Wis., 1954.

Epitrix hirtipennis (Melsh.) is an important pest of flue-cured tobacco in Virginia and caused severe foliage injury and root damage during the 1953 transplanting season. Tests were therefore made with organic insecticides for its control in plant beds, on the newly set plants and on field tobacco.

In plant beds, treatments were applied twice, on 17th April and again on 7th May, the rates of application being 3 and 6 U.S. gals. per 100 sq. yards, respectively, for sprays and 0.5 and 1 lb. for dusts. Examination on 13th May showed that sprays containing 1.5 lb. 75 per cent. wettable DDT or 25 per cent. wettable dieldrin or 1 U.S. quart 18.5 per cent. endrin emulsion concentrate per 100 U.S. gals. and dusts containing 5 per cent. CS-708 [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] or DDT, 2 per cent. isodrin or 1 per cent. dieldrin resulted in 43-56 per cent. uninjured plants and 8-13 flea-beetles per five sweeps of the net, as compared with no plants uninjured and 56 flea-beetles for no treatment.

In tests of pretreatment in the plant bed for the protection of newly set tobacco, sprays were applied at 6 U.S. gals. and dusts at 1.5 lb. per 100 sq. yards and counts of flea-beetles on the plants were made 5, 10 and

14 days after transplanting. A spray of 1.5 lb. 25 per cent. wettable dieldrin per 100 U.S. gals. was more effective than one of 1.5 lb. 75 per cent. wettable DDT, and a dust of 5 per cent. DDT was superior to the DDT spray and to dusts of 2 per cent. isodrin, 1 per cent. dieldrin or 5 per cent. CS-708; all treatments caused great reductions in flea-beetles and leaf punctures. Two systemic insecticides, demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate] and G-23611 (1-isopropyl-3-methyl-pyrazolyl(5) dimethylcarbamate [Isolan]), were also tested for the protection of the newly set plants, various dilutions being applied in water at 65 ml. per plant in place of the transplant water commonly used. Demeton at dilutions of 1:1,600-1:12,800 and G-23611 at 1:1,600 and 1:3,200 caused considerable reductions in flea-beetle populations 5-14 days after treatment and 30-72 per cent. reduction in the average number of leaves punctured. Populations were similar to those in untreated plots 30 days after treatments. Demeton resulted in less plant growth at 1:1,600-1:3,200 than at 1:6,400 or 1:12,800 but in more than in untreated plants, and G-23611 caused no phytotoxic symptoms and also improved growth.

In tests on field tobacco with dusts applied at 20 lb. per acre, 5 per cent. DDT or CS-708, 2 per cent. isodrin and 10 per cent. DDD (TDE) all caused considerable reductions in the numbers of flea-beetles per plant 1-8 days after treatment; DDT and isodrin showed the greatest and DDD the least persistent effect. With sprays applied at about 11 U.S. gals. per acre, endrin at 0.1-0.4 lb. active ingredient per acre caused greater and much more rapid reductions in *Epitrix* (more than 95 per cent. 1-8 days after treatment) than DDD, which was applied at 0.5-1.5 lb. per acre and proved unsatisfactory.

WOODSIDE (A. M.). Japanese Beetle Damage to Corn as influenced by Silking Date.—*J. econ. Ent.* **47** no. 2 pp. 349-352, 2 refs. Menasha, Wis., 1954.

The Japanese beetle [*Popillia japonica* Newm.] feeds on various parts of the maize plant, but the most serious injury is due to feeding by the adults on the silks and ear tips, which may completely prevent pollination of many ears and interfere with that of others. Observations in Virginia in 1951-53 indicated that most of this damage can be avoided if the maize reaches the silking stage before the period of heavy infestation begins or after most of the beetles have disappeared. In 1951-53, no severe injury was found in maize that reached the silking stage before 20th July or after 1st August. The presence of preferred food-plants of the beetles in woods or hedgerows adjacent to maize fields may result in more severe damage to the maize if it is silking when the beetles are abundant, but will not result in severe injury otherwise. The presence within a field of a heavy stand of a favoured weed food-plant may result in more severe damage and also in the extension into the field of the area of severe damage, which is usually along the edges. Since *P. japonica* became common in northern Virginia, maximum adult infestation has always occurred between 23rd and 27th July, except in 1950, when it was about two weeks later, and maize should therefore be sown so that it will not silk during the last ten days of July.

CHAO (Yung-chang) & ROBERTS (J.). A Dust Mixer for economic Poisons.—*J. econ. Ent.* **47** no. 2 pp. 353-354, 1 fig., 1 ref. Menasha, Wis., 1954.

Details are given of an apparatus designed to blend insecticides with samples of wheat varying from less than an ounce up to 5 lb. It is rapid and thorough in action and may be useful for other laboratory purposes.

GREEN (H. B.). **Peach Insect Control with low-gallonage Spray in Mississippi.**—*J. econ. Ent.* **47** no. 2 pp. 354-355. Menasha, Wis., 1954.

Since insect control on peach is inadequate in many domestic orchards because of the trouble and time required to apply sprays, tests to determine whether it was necessary to cover the entire tree to control the plum curculio [*Conotrachelus nenuphar* (Hbst.)] and the oriental fruit moth [*Cydia molesta* (Busck)] were made in Mississippi in 1950-53. Several chlorinated-hydrocarbon insecticides were applied in the ordinary way to give complete coverage of the foliage and also at three times the concentration to the fruits only, the amounts of toxicant per tree being the same in both cases. The results for the years in which valid comparisons were obtained showed that the latter method was equal or superior to complete coverage against both insects in the fruits and also, surprisingly, against *C. molesta* in the twigs.

JAYNES (H. A.). **Parasitization of Spruce Budworm Larvae at different Crown Heights by *Apanteles* and *Glypta*.**—*J. econ. Ent.* **47** no. 2 pp. 355-356. Menasha, Wis., 1954.

As the limited records had shown little difference in the percentage parasitism of *Choristoneura fumiferana* (Clem.) on balsam fir [*Abies balsamea*] by *Apanteles fumiferanae* Vier. and *Glypta fumiferanae* (Vier.), the two principal parasites of the overwintering larvae, at different heights in the tree, all larvae collected during investigations on the distribution of the Tortricid on balsam fir in northern Maine in late April in 1951 and 1952 were dissected. The percentages parasitised at different heights (7-47 ft. above ground) are shown in a table, and when the samples were graded according to crown level, the percentages of larvae parasitised by *Apanteles* and *Glypta*, respectively, were 14 and 6 in the lower part, 21 and 10 in the middle and 35 and 9 in the top. There was no significant difference in parasitism between trees, though the numbers of *C. fumiferana* per tree varied from 65 to 462.

FLESCHNER (C. A.) & RICKER (D. W.). **Typhlodromid Mites on *Citrus* and Avocado Trees in southern California.**—*J. econ. Ent.* **47** no. 2 pp. 356-357, 1 ref. Menasha, Wis., 1954.

Investigations on the predacious mites that occur on *Citrus* and avocado in southern California showed the presence of six described and two undescribed species of *Typhlodromus*. A list of these is given, together with records of phytophagous mites on which they fed when confined with them on orange fruits or avocado leaves in the laboratory. Those that occurred on both *Citrus* and avocado comprised *Typhlodromus finlandicus* (Oudm.), which fed on *Paratetranychus* (*Metatetranychus*) *citri* (McG.), *Aceria sheldoni* (Ewing) and *P. coiti* McG., *Typhlodromus conspicuus* (Garman), which was particularly common on avocado heavily infested by *Tydeus californicus* (Banks), was the only species tested that fed on *Tydeus* and did not attack any other plant-feeding mite, and *Typhlodromus longipilus* Nesbitt, which fed on *P. coiti* and *Tetranychus bimaculatus* Harvey. An undescribed species of *Typhlodromus* near *finlandicus* was found only on avocado and fed on *P. citri*, *P. coiti*, *Tetranychus sexmaculatus* Riley, *T. bimaculatus* and *A. sheldoni*. A few examples of *Typhlodromus similis* (Koch) were found on an apple tree in an avocado grove, but otherwise it

likewise occurred only on avocado; it fed on *P. coiti* and *Tetranychus bimaculatus*. The other species found were *Typhlodromus masseei* Nesbitt, *T. pomi* (Parrott) and *Typhlodromus* sp.; their feeding habits were not studied. Of the mites tested, those that fed on both *P. citri* and *P. coiti* were readily transferred from avocado leaves to *Citrus* fruits and back without apparent detrimental effects, and so can probably live on a variety of plants.

ELMORE (J. C.) & RANNEY JR. (C. A.). Injury to Pepper Plants by the Pea Leaf Miner.—*J. econ. Ent.* **47** no. 2 pp. 357-358, 1 fig., 2 refs. Menasha, Wis., 1954.

Injury to 500 acres of newly sown chili peppers [*Capsicum*] by *Liriomyza langei* Frick was observed in May 1953 in Orange County, California. Adults that emerged from self-sown sugar beet along roadsides and hedge-rows punctured the primary leaves of the seedlings so severely that many died, and larvae developed in primary and secondary leaves, causing them to curl. Peppers are not a natural food-plant of *Liriomyza* and were not attacked at later stages, but the stunting and killing of the seedlings caused considerable loss.

When week-old seedlings that had been protected by wire cages since their first appearance were exposed to *Liriomyza* adults, extensive puncturing of the leaves was noticed and three weeks later the plants were about half as large and half as heavy (dry weight) as control plants continuously protected.

BURKHARDT (C. C.). Control of Injury by Western Corn Rootworm Adults.—*J. econ. Ent.* **47** no. 2 pp. 358-359, 1 fig., 1 ref. Menasha, Wis., 1954.

Adults of *Diabrotica virgifera* Lec. feed on all parts of the maize plant above ground, but are most injurious to the silks. In north-central Kansas in 1953, they were present in large numbers, amounting to more than 100 on many plants. They severed the silks close to the tips of the ears, with the result that fertilisation was incomplete, and frequently fed on the well-filled kernels at the tip of the ear for a distance of two inches. *D. virgifera* should normally be controlled in the larval stage, but if the adults become a threat to pollination, special measures are necessary. In 1953, some 3,000 acres of maize in Kansas were sprayed by aeroplane with an undiluted 25 per cent. DDT emulsion concentrate to give 2 lb. DDT per acre, which resulted in even and satisfactory coverage and no scorching. Applications were usually made when most of the maize was in tassel or when the first silks began to appear, and counts showed that the numbers of living and dead beetles per plant averaged 34 and 0 before and 1.5 and 33 twelve hours after spraying, indicating a kill of 95.4 per cent. Practically all the beetles were dead 36 hours after treatment.

MACCREARY (D.). Evaluation of Trunk Sprays against Peach Tree Borers in Delaware.—*J. econ. Ent.* **47** no. 2 pp. 359-360, 2 refs. Menasha, Wis., 1954.

Both *Aegeria* (*Sanninoidea*) *exitiosa* Say and *A.* (*Synanthedon*) *pictipes* G. & R. have become more abundant on peach in Delaware in recent years, particularly since trunk sprays of DDT have replaced treatment with p-dichlorobenzene. The reason may be that only one or two applications

are made instead of three, and these at unsuitable times, but DDT has in any case been shown to be ineffective against *A. pictipes* [cf. *R.A.E.*, A 40 77]. Several insecticides were therefore tested in 1952 as trunk sprays on trees up to 4 ins. in diameter at the soil surface. The sprays were applied to all sides of the trunk and main branches, with particular attention to the base of the tree, and each material was used alone on 27th May, 17th June, 10th and 31st July and 21st August or with an adhesive on the first, third and fifth of these dates, the choice being based on previous observations of the emergence periods of the two species. Examination of trees uprooted in the autumn of 1952 or the spring of 1953 showed that the average numbers of larvae of *A. exitiosa* per tree were reduced from 18 for no treatment to 0.63 or less by treatment with 8 lb. DDT, 4 lb. BHC, 2 lb. parathion or dieldrin or 1.25 lb. EPN [ethyl p-nitrophenyl thiobenzene-phosphonate] per 100 U.S. gals., either alone or with the adhesive. Five applications of any of the materials alone gave slightly better control than three with the adhesive, but the improvement was not enough to justify the additional expense. It is concluded that any of these materials should give good commercial control of *A. exitiosa* if the sprays are properly timed and thoroughly applied. The expected infestation by *A. pictipes* did not develop.

HAMILTON (D. W.) & FAHEY (J. E.). **DDT fails to control *Erythroneura lawsoniana*.**—*J. econ. Ent.* 47 no. 2 pp. 361-362. Menasha, Wis., 1954.

Since the general adoption of DDT for the control of pests on apple in the Middle West of the United States, leafhoppers have been very scarce, but in 1953, they were numerous from July onwards in an orchard in Kentucky that received seven cover sprays of 2 lb. 50 per cent. DDT per 100 U.S. gals., finishing on 10th-15th August, and in which leaves still bore residues of 3.8 mmg. per sq. cm. on 8th September. Adults were identified as *Erythroneura lawsoniana* Baker, one of the common Jassids on apple in the midwestern States [cf. *R.A.E.*, A 20 138], and the same species had probably been present in earlier years. On 8th September, infested trees and the ground round them were sprayed with 1-2 lb. 50 per cent. DDT, 1 U.S. pint nicotine sulphate or 1 lb. 15 per cent. parathion per 100 U.S. gals., and examination of the trees about an hour later showed that nicotine sulphate had caused the greatest immediate kill, whereas DDT and parathion had little effect. A further examination the following morning confirmed that nicotine sulphate caused substantial reductions in population and that DDT and parathion were ineffective. Residue determinations on leaves as soon as they had dried showed deposits of 10.1 and 16.1 mmg. per sq. cm. from 1 and 2 lb. 50 per cent. DDT and 1.2 mmg. from parathion. It is concluded that a strain of *E. lawsoniana* resistant to DDT may have developed in the orchard.

WESSEL (R. D.). **Cutworm Control in Muckland Carrots.**—*J. econ. Ent.* 47 no. 2 p. 362. Menasha, Wis., 1954.

Larvae of *Agrotis* sp. regularly attack crops grown on the mucklands near Elba, New York, in June and July, and the usual control methods of dusting, spraying or baiting during this period are often ineffective, as the top soil is continually moved by high winds. In the course of investigations on the control of *Psila rosae* (F.) on carrots, a drench-type multiple drill was used on 4th May 1953 to sow the seed and to drench this and the

furrow of each row with 1.5, 2 or 3 lb. actual parathion (from a liquid concentrate) per 100 U.S. gals. per acre. Seedling emergence was not affected, and as it was apparent by mid-June that injury by *P. rosae* would be masked by heavy nematode infestation, the experiment was abandoned, but during late June, when there was extensive cutworm activity throughout the area, carrots were found to be abundant in treated areas but almost absent in untreated ones. Larvae of *Agrotis* sp. were numerous in the untreated areas, but only four, all of which appeared to be poisoned, were found in treated ones. The field received no other treatment, and the treated portion produced a good stand throughout the season; it is therefore concluded that such treatments may afford an efficient and practical method of protection.

BECKER (W. B.). **The Old House Borer in Massachusetts.**—*J. econ. Ent.* **47** no. 2 pp. 362-363, 1 fig. Menasha, Wis., 1954.

Hylotrupes bajulus (L.), which infests the sapwood of seasoned coniferous timber and is well known in Europe, has been present in the United States for a number of years, though there are few published reports of its occurrence there. Damage due to it has been observed in 19 localities in Massachusetts since 1939, some of the buildings infested being comparatively old. Most of the infestations occurred between Worcester and the coast, and the insect was actually taken in 14 of them.

CHAMBERLAIN (W. F.). **Repellents for Corn Earworm Control.**—*J. econ. Ent.* **47** no. 2 pp. 364-365. Menasha, Wis., 1954.

As the treatment of maize with DDT in oil emulsion or dusts for protection against the corn earworm [*Heliothis armigera* (Hb.)] is expensive and of limited value, preliminary experiments were carried out in South Carolina in 1953 with a number of substances that were thought likely to act as repellents and so protect the ears if applied once by aeroplane at the beginning of silking. Many were oils or solids that might injure the plants if applied in sprays, and they were therefore tested as dusts, in order to reduce contact. They were first dissolved in acetone, and made into a slurry with diatomaceous earth, and this was then dried and ground and applied to the silks of sweet maize.

In June, when the dusts were applied with a brush on the day after the silks appeared, 0.5 per cent. allethrin, 1.5 per cent. parathion, 2 per cent. pyrethrum, 25 per cent. pine tar oil or 50 per cent. pyridine, formaldehyde, benzyl chloride, p-dichlorobenzene or β -naphthol gave little or no protection, whereas 50 per cent. turpentine, 15 per cent. parathion and 2.5 and 25 per cent. Diazinon [O,O -diethyl O -2-isopropyl-4-methyl-pyrimidinyl(6) thiophosphate] resulted in 17.2, 52, 21 and 75 per cent. uninfested ears, respectively, as compared with none in untreated plots. All the dusts interfered with pollination, particularly that containing pyrethrum, which reduced it from 93 to 10 per cent., probably owing to the inclusion in the dust of its synergist, n-octyl sulphoxide of isosafrole. Only larvae of *H. armigera* were found in the ears.

In August, when the dusts were applied with a small puff-type duster 1-3 times from the third day of silking, 40 per cent. turpentine, 15 per cent. parathion, 25 per cent. Diazinon and 25 per cent. Ovotran [p-chlorophenyl p-chlorobenzenesulphonate] increased the percentage of marketable ears (those having not more than one inch of the tip damaged or infested by small larvae) from 7.9 to 24.4, 85.6, 71.3 and 15.2, respectively, and 40

per cent. pine tar oil and 25 per cent. triethanolamine were ineffective. Larvae of *H. armigera* and the fall armyworm [*Laphygrma frugiperda* (S. & A.)] were found in the ears. None of the materials affected pollination.

The dusts made the silks turn brown more quickly than usual, but none scorched the husk or leaves; however, further tests with benzyl chloride, which is a strong skin irritant, are not recommended.

DEAN (H. A.). **Termites in *Citrus* on newly-cleared Brushland.**—*J. econ. Ent.* **47** no. 2 pp. 365-366, 1 ref. Menasha, Wis., 1954.

The author reports that many orange and grapefruit trees planted in 1946 and 1947 near Edinburg, Texas, immediately after the removal of brushwood, and interplanted with cotton for several years, were destroyed in 1952 by *Paraneotermes (Kalotermes) simplicicornis* (Banks) [cf. *R.A.E.*, A **40** 116]. The termites were found only in the planted area, weeds that were allowed to grow between the trees for protection against wind apparently supplying adequate cover for them. The problem became acute when the trees were banked against frost, since infested soil was in some cases thrown against them. Comparisons of insecticides applied in the normal irrigation water (60 U.S. gals. per tree) for 6 ft. round each tree showed that lateral water penetration in banked soil was insufficient to carry the insecticide to within eight inches of the tap root. The liquid moved almost straight down, about a third of it to below the lateral root zone, where it was considered to be wasted. Round unbanked trees, the same amount of liquid penetrated to a depth of 14-15 ins. and dispersed the insecticide adequately about the lateral roots. In all, 478 banked and unbanked trees were treated, and termites were found round the roots of six unbanked ones 18 days or more after the application of 0.5 lb. or less chlordane, aldrin or parathion per 50 trees, but not round those of any receiving 1-2 lb. chlordane per 50 trees.

MICHELBACHER (A. E.), FULLMER (O. H.), CASSIL (C. C.) & DAVIS (C. S.). **Walnut Aphid resistant to Parathion in northern California.**—*J. econ. Ent.* **47** no. 2 pp. 366-367, 1 graph. Menasha, Wis., 1954.

Parathion gave excellent control of *Chromaphis juglandicola* (Kalt.) on walnut in an orchard near San Jose, California, until 1952, after which constantly increasing dosages were required. When walnut leaves bearing Aphids from this orchard and from one in which susceptibility was normal were dusted with 0.5 per cent. parathion in a vacuum bell-jar duster and examined for mortality four hours later, it was found that the median lethal deposits of the dust were 140 and 20 mg., respectively. In field tests in the San Jose orchard, trees having 27.3 Aphids per leaf, were sprayed with 2 lb. 25 per cent. wettable parathion in 100 U.S. gals. water per acre on 23rd August and showed 1.3 Aphids per leaf on the next day. This was considered unsatisfactory, as the population should be practically eliminated for adequate control with parathion, because of the destruction of natural enemies. Numbers increased to 19.8 by 17th September, and the rate of increase would have been even greater but for an unusually heavy invasion of predators. Treatment with 9 lb. 14 per cent. nicotine dry concentrate per 100 U.S. gals. per acre resulted in 0.4 Aphids per leaf on 24th August and 1.9 on 17th September, control being maintained by natural enemies, which were not affected. On trees sprayed commercially, a dosage of about 3 lb. 25 per cent. wettable parathion per acre was necessary for satisfactory control, which is three times the normal rate.

It is concluded that the San Jose Aphids had developed resistance to parathion. They showed no morphological differences from the normally susceptible Aphids.

WALKER (R. L.) & HAIDARI (H. S.). **Effectiveness of certain Insecticides against the Spiny Bollworm in Iraq.**—*J. econ. Ent.* **47** no. 2 pp. 367-369. Menasha, Wis., 1954.

Earias insulana (Boisd.) is a major pest of cotton in Iraq, where it sometimes causes 80 per cent. loss in yield of seed cotton [*cf. R.A.E.*, A **41** 219], and dusts containing calcium arsenate, lead arsenate, sodium fluosilicate, barium fluosilicate and a mixture of BHC and DDT gave little or no control in limited tests in 1937-51. In 1952, chlorinated hydrocarbons were tested in emulsion sprays, which were applied eight times at about 30 U.S. gals. per acre before 8 a.m., when the air was fairly calm.

In the first experiment, in which applications were made between 16th July and 28th September, comparisons of square and boll injury showed that endrin at 1.5 or 2 lb. per acre was significantly better than dieldrin at the same rates, but both gave excellent control, with no significant difference between doses. Field observations showed a positive relation between the degree of injury caused by *Earias* and the number of bolls infected with *Rhizopus nigricans* and *Aspergillus niger*; penetration of the boll during feeding apparently afforded an entry for the fungi. The numbers of bolls infected with them showed no significant differences between treatments, but there were five times as many on untreated plants as on those treated with endrin.

In the second experiment, in which sprays were applied between 10th August, when over 50 per cent. of the squares were injured, and 13th October, endrin at 0.5 and 1 lb. per acre gave significantly better control than 1 lb. dieldrin or 6 lb. toxaphene. There was no significant difference in bollworm damage between the two rates of application of endrin, but the higher one gave a significantly higher yield of seed cotton than any other treatment; all treatments significantly increased the yield. An unidentified species of *Tetranychus* increased on the cotton during September in this experiment and was much more abundant in plots treated with endrin or dieldrin than in others; one application of dusting sulphur gave fair control. In January, there were significantly more pupae of *Earias* attached to the soil surface or surface débris in plots treated with toxaphene and dieldrin than in those receiving endrin, but all treated plots showed considerably fewer pupae than untreated ones.

ASQUITH (D.). **Egg-laying Periods of the Red-banded Leaf Roller in southern Pennsylvania.**—*J. econ. Ent.* **47** no. 2 p. 374, 2 refs. Menasha, Wis., 1954.

One of the difficulties in controlling *Eulia (Argyrotaenia) velutinana* (Wlk.) on apple in southern Pennsylvania is the timing of spray applications so as to kill the maximum number of larvae of each generation. Observations in cages and on young trees in 1952 and 1953 showed that eggs of the first generation were deposited from 16th April to 14th May and from 1st April to 10th May, respectively, those of the second from 16th June to 14th July and from 10th June to 10th July, and those of the third from 25th July to 23rd August and from 21st July to 24th August. In each generation, oviposition continued in the field for 7-10 days after it had finished in the cages. As the periods over which second- and third-generation eggs are laid are so long, attempts to control the larvae by

applying one spray against each of these generations are likely to fail, especially in seasons in which conditions are favourable for insect development. In 1953, apples in some heavily infested orchards were injured because the residue from one spray of DDD (TDE), applied in early August, did not remain toxic long enough to kill the larvae that hatched from eggs deposited after 15th August.

NIJVELDT (W.). Galmuggen van cultuurgewassen. IV. Galmuggen, schadelijk aan landbouwgewassen. [Gall-midges on cultivated Plants. IV. Gall-midges injurious to Crops of agricultural Importance.]—*Tijdschr. PlZiekt.* **60** pt. 2 pp. 83–92, 39 figs., 20 refs. Wageningen, 1954. (With a Summary in English.)

The species dealt with in this part of a series on Cecidomyiids in Holland [cf. *R.A.E.*, A **42** 275, etc.] comprise *Contarinia medicaginis* Kieff. on lucerne, *C. nasturtii* (Kieff.) on turnip, *C. pisi* (Winn.) on peas, *C. tritici* (Kby.), *Mayetiola destructor* (Say) and *Sitodiplosis mosellana* (Géh.) on wheat, *Dasyneura brassicae* (Winn.) on rape and *Giraudiella inclusa* (Frauenfeld) on reed. The damage caused is described, and information is given on bionomics, other food-plants and distribution, except for species included in previous parts [cf. **42** 239].

WALRAVE (J.). Proeven met systemische insecticiden. I. [Experiments with Systemic Insecticides. I.]—*Tijdschr. PlZiekt.* **60** pt. 2 pp. 93–108, 5 graphs, 19 refs. Wageningen, 1954. (With a Summary in English.)

In laboratory investigations in Holland on the possible use of systemic insecticides against Aphid vectors of potato viruses to facilitate the raising of healthy seed potatoes, Pestox 3, containing 66 per cent. active ingredient [schradan], and Systox, containing 50 per cent. toxicant [diethyl 2-(ethyl-mercapto)ethyl thiophosphate] were applied to the leaves, mostly of young plants, either with a brush or by spraying, and apterous adult Aphids that had been reared under conditions as nearly identical as possible were enclosed on the leaves, at various intervals after the deposit had dried, in cages already described [*R.A.E.*, A **40** 279].

The rapidity of action of Pestox 3 was tested against *Aphis fabae* Scop. on beans (*Phaseolus vulgaris* and *Vicia faba*) and *Myzus persicae* (Sulz.) on potato. The standard of comparison selected was the time required for 85 per cent. mortality, since the increase in mortality with time was usually regular up to that level but fell off above it. The leaves were brushed with up to 1 cc. liquid containing 0.05–0.4 per cent. active ingredient, 0.1 cc. being applied at a time and successive applications made when the previous one was dry, and the Aphids were caged on the leaves after 3–46 hours. The results were the same whether the Aphids were placed on the treated or the untreated side of the leaf, and no amount of insecticide per leaf caused 85 per cent. mortality of either Aphid in less than about 40 hours, some large amounts even requiring much longer. The effect of different concentrations of Pestox 3 under equal conditions was tested against *A. fabae* on *V. faba*. The plants were sprayed to run-off once with 0.1–0.6 per cent. active ingredient or 1–3 times with 0.8 per cent. and the Aphids caged on them 71 hours later. The speed of action increased with concentration up to 0.6 per cent., which caused 85 and 100 per cent. mortality in about 40 and 65 hours, respectively, but greater amounts of insecticide were no more effective. Similar results were obtained against *M. persicae* on potato.

Systox was more rapid in action than Pestox 3, and gave complete mortality in a few hours at a suitable concentration. Mortality of *M. persicae* caged on rather old potato plants 20 hours after treatment with 0·1-0·2 per cent. toxicant reached 85 per cent. within about 18-23 hours, and similar results were obtained against *Macrosiphum (Aulacorthum) solani* (Kalt.). Lower concentrations were sometimes toxic sooner than high ones, the reason for this being unknown. When young and old potato plants of the same variety were sprayed with equal concentrations of Systox, the young plants became toxic to *Myzus persicae* sooner than the old ones.

In investigations on persistence, potato plants in pots were sprayed with Pestox 3 or Systox at 0·2 and 0·1 per cent. active ingredient, respectively, and apterae of *M. persicae* were placed on them after 24, 192 or 564 hours in the case of Pestox 3 and 7, 194 or 513 hours in that of Systox. Systox was again the more rapid in effect, and though the toxicity of both materials diminished with time, it was still considerable after 3-3½ weeks. Similar results were obtained with Systox at 0·1-0·2 per cent. active ingredient against *Macrosiphum solanifolii* (Ashm.) (*euphorbiac*, auct.) on potato, against which Aphid it was still effective after a month.

The results to be expected in the field from the use of systemic insecticides on potato are discussed in the light of these findings and of information in the literature. The virus of leaf-roll requires an incubation period of 48 hours in the insect [cf. 40 271], so that neither apterae nor alates arriving uninfected in a treated plot would live long enough to constitute a danger, but alates already infected on arrival would be capable of at least limited transmission. Less satisfactory results are to be expected with virus Y, which can be acquired and transmitted in a few seconds. It is concluded that treatment with Pestox 3 or Systox might well reduce but not entirely prevent virus infection.

BÖHM (O.). Das Schadaufreten der Veilchenblattrollmücke (*Dasyneura affinis* Kieff.) in Österreich und die Bekämpfungsmöglichkeiten mit synthetischen Insektiziden. [The injurious Occurrence of *D. affinis* in Austria and the Possibilities of Control by Means of Synthetic Insecticides.]—*Pflanzenschutzberichte* 12 pt. 3-4 pp. 41-53, 2 figs., 13 refs. Vienna, 1954. (With a Summary in English.)

NOVITZKY (S.). Beschreibung einer neuen Unterart von Calliceratiden an *Dasyneura affinis*. [Description of a new Subspecies of Ceraphronid from *D. affinis*.]—*T.c.* p. 54. (With a Summary in English.)

It is reported in the first paper that an outbreak of *Dasyneura affinis* (Kieff.) on wild and cultivated violets (*Viola odorata*) in Lower Austria and Vienna began in 1952. The adults had 15 antennal segments, the galls on the leaves were hairy, and other species of *Viola* growing nearby were not infested [cf. *R.A.E.*, A 43 19]. The Cecidomyiid had four generations in 1952 and three in most areas in 1953, with periods of maximum flight occurring in April, June, August and October of the first year, and May, July and September of the second. Infestation by the end of the season was about equally heavy in both years.

Since parathion sprays applied by growers gave inconsistent results, laboratory experiments were carried out in which galls from which emergence had not begun were immersed for 1-3 minutes in 0·05 per cent. Systox (containing 50 per cent. diethyl 2-(ethylmercapto)ethyl thiophosphate) or 0·06 per cent. of a preparation containing 45-47 per cent. parathion, dried for an hour on filter paper, and stored in glass cylinders covered with

gauze, in which humidity was maintained by means of moist cotton-wool. Observations on adult emergence were made after a fortnight, and the contents of the galls investigated. Emergence from untreated galls placed in some of the cylinders with those that had been immersed in Systox was the same as in the controls, so that there was apparently no fumigant effect. The results showed that neither Systox nor parathion gave good mortality of larvae or pupae in cocoons, though the first was considerably more effective against larvae that had not yet spun cocoons and the second killed most of the adults as they emerged. It is concluded that insecticides are best applied during the period of maximum flight to control the adults and young larvae.

In a preliminary field test in 1952, 0.05 per cent. Systox and a DDT dust were applied to the plants on 23rd April, immediately before the main emergence of the overwintered generation. On 13th May, new galls were absent from the treated plants though they were numerous on the controls, and inspection a month later showed that 21 of 35 plants sprayed with Systox were uninfested, with a total of 38 galls on the remainder, and 31 of 40 dusted with DDT were uninfested, with 23 galls on the remainder, as compared with 41 plants all infested and a total of 465 galls for no treatment. In a further test in June, 0.05 per cent. Systox, 0.5 per cent. Pestox 3 H (66 per cent. schradan) and 0.2 per cent. Isopestox (90 per cent. bis(monoisopropylamino)fluorophosphine oxide) were applied as sprays or poured round the roots of the plants and compared with 0.06 per cent. of the parathion product as a spray and the DDT dust. All treatments were applied 2-3 days before the main flight of the first generation began, and the sprays and dust again a few days after it ceased. The results were assessed by examining the pupae in galls of the first generation in July and counting the galls of the second generation in August. It was again found that stages in the cocoon were little affected by any treatment. The root treatments with Systox and Isopestox were unsatisfactory in their later effects, but all the other treatments gave complete or almost complete protection against the second generation.

Natural enemies were of little importance for control, those observed comprising Chrysopid larvae that were predacious in the galls and the Chalcidoid parasites, *Systasis encyrtoides* Wlk., *Tetrastichus* sp., probably *T. brevicornis* (Panz.), and a new subspecies of *Ceraphron* (*Calliceras*) *clavatus* (Ratz.) described by Novitzky in the second paper from adults of both sexes as *violae*, subsp. n.

BÖHM (H.). *Auftreten von Quadraspidiotus schneideri n.sp. (Homopt. Diaspidoid.) in Österreich. (Kurze Mitteilung.)* [The Occurrence of *Q. schneideri* in Austria. (Short Communication.)]—*Pflanzenschutzberichte* 12 pt. 3-4 pp. 55-57, 6 refs. Vienna, 1954. (With a Summary in English.)

Since F. Bachmann in 1952 identified Coccid specimens from Lower Austria as *Quadraspidiotus schneideri* Bachmann [cf. *R.A.E.*, A 42 350], a survey for this Coccid was begun in the autumn of that year. It was found to occur in several provinces, almost entirely on fruit trees and mainly on apple and pear. *Q. schneideri* was parasitised by *Aphytis proclia* (Wlk.) (*diaspidis* How.), *Archenomus bicolor* How. and *Apterycyrtus microphagus* (Mayr), but the degree of parasitism was low. Predators were more effective, especially the Coccinellid, *Chilocorus bipustulatus* (L.), and the Nitidulid, *Cybocephalus politus* (Gylh.), and considerable numbers of Chrysopid larvae were repeatedly observed attacking the Coccids.

SCHWENKE (W.). **Beiträge zur Bionomie der Kiefernspanner *Bupalus pinarius* L. und *Semiothisa liturata* Cl. auf biozönotischer Grundlage.** [Contributions to the Bionomics of *B. pinarius* and *S. liturata* on a biocoenotic Basis.]—*Beitr. Ent.* 3 no. 1-2 pp. 168-206, 3 graphs, 25 refs. Berlin, 1953.

Some elements in the bionomics of forest pests, such as the oviposition rate, the pupal weight and the duration of development, depend considerably on environment, and discrepancies in the values given in the literature for individual species probably result from differences in the conditions under which the observations were made. Conditions in the field vary with time and locality, but constant differences in environment should be accompanied by constant differences in bionomics. This was shown to be the case with regard to population densities of *Bupalus pinarius* (L.) and *Semiothisa liturata* (Cl.) [R.A.E., A 41 337], and further investigations are recorded on the bionomics of these two species in relation to environment, carried out in the laboratory and in a pine forest near Berlin of one of the biocoenotic types (*Fragaria-Vaccinium*) previously distinguished by the author [loc. cit.], subdivided on similar floristic bases into a moist and a dry section. The results are compared with those recorded in the literature. The numbers of pupae per six sq. yards in the winters of 1950-51 and 1951-52 were 7.5-8 for *Bupalus* and 12-9 for *Semiothisa* in the moist section and 10-11.5 and 3-7, respectively, in the dry one. In both sections, about ten per cent. of the pupae were parasitised and under five per cent. attacked by fungi. The average weights of pupae of both sexes from one or both forest sections in 1951-53 are given in a table. There appeared to be a constant difference between the two sections, for *B. pinarius*, the heavier pupae coming from the dry one, but not for *S. liturata*. The pupae were weighed between February and May, and the results were corrected where necessary to refer to weight in April, it having been found that female pupae of *B. pinarius* kept at 18°C. [64.4°F.] and 100 per cent. relative humidity from the time of pupating in November lost about five per cent. in weight by the beginning of February. Pupae of *S. liturata* collected and weighed in August-September and kept under the same conditions were killed by fungi, but others collected from the same locality at the end of April weighed about 12 per cent. less, so that a loss of 10-15 per cent. is assumed. Males were more numerous than females, especially in *S. liturata*, but the differences were not statistically significant.

Emergence of the adults of both species occurred in the field between May and July, that of *S. liturata* beginning first and ending last, and when pupae of *B. pinarius* taken from the dry forest section early in April were kept in soil on a balcony, the first males emerged several days before the females. Adults of *B. pinarius*, particularly the females, remained almost exclusively at the level of the crowns of the trees, while those of *S. liturata* seldom occurred over 12-13 ft. above the ground. *S. liturata* was stronger and swifter in flight than *B. pinarius* and as susceptible to wind.

The eggs of *B. pinarius* are deposited on the needles and batches averaging 5-12 and 2-7 are recorded in the literature. The females reared by the author in 1951 deposited ten per cent. of their eggs singly, though batches of up to 30 were observed. The difference is attributed to the fact that previous data were obtained during outbreaks, whereas the examples reared in 1951 originated from a population at normal density. The average number of eggs in the batches obtained was four. Most eggs were deposited on the first day of oviposition, and the oviposition period of three fertilised females was 6-8 days, the numbers of eggs laid being 204-213. Eggs of *S. liturata* on pine were stated by Hofmann to be deposited at the base of the needle sheaths [30 245], but less than five per cent. were found in this

position, the remainder being deposited at random on the twigs and mostly well concealed. Three fertilised females oviposited for 4, 6 and 11 days, laying 143–172 eggs each.

The relation of pupal weight to egg-production is discussed. It is known to be linear in Lepidoptera and is constant for any one generation of a given population, though not for different generations and localities. The probability of its being constant in different years for forest of a given ecological type is considered. It was so for *B. piniarus* in the dry forest environment in 1951 and 1952, but genetic degeneration during outbreaks [cf. 40 16] has been known to reduce egg-production in *Lymantria monacha* (L.) without affecting pupal weight [35 239], so that a constant relation would apply only to populations at normal density.

The egg stage of *B. piniarus* lasted 17.5, 14.5 and 11.5 days at a constant relative humidity of 75 per cent. and temperatures of 18, 20.5 and 24°C. [64.4, 68.9 and 75.2°F.], respectively, and these results were consistent with those of Schwerdtfeger [18 698]. It was not much affected when the relative humidity was reduced to 50–60 per cent., but lasted up to 1½ days longer at 100 per cent. Eggs of *S. liturata* at the same three temperatures and 50–75 per cent. relative humidity hatched in 11.2, 9 and 7 days, and the threshold of development was calculated to be 8°C. [46.4°F.]. Development was slightly retarded at 100 per cent. relative humidity.

Larvae of *B. piniarus* originating from the dry forest environment in 1951 and from both environments (mixed) in 1952 were reared on fresh pine twigs in the laboratory at 75 per cent. humidity and about 18, 21 [69.8°F.] and 24°C., and also on a covered balcony under natural conditions. In 1951, the duration of each of the first four instars in the laboratory, calculated from measurement of head-capsules, decreased with increasing temperatures, but that of the fifth increased with temperature, so that total larval development averaged 59–62.5 days and was thus hardly affected by change in temperature. A similar result was observed in 1952, when the duration of the fourth instar was unaffected by temperature and that of the fifth increased with it, complete larval development averaging 58.5, 80 and 96 days at the three temperatures, respectively. On the balcony, the larval stage lasted 117 days in 1951 and 123.5 in 1952. Since conditions in the laboratory had been virtually the same in both years and the larvae reared on the balcony required longer to complete their development in 1952, when adults in the field emerged early, it is suggested that one function of the last two instars may be to prolong the cycle of development in such years so as to facilitate maximum feeding. The numbers of days required for larval development of *S. liturata* from similar sources under the same conditions in 1951 and (in brackets) 1952 averaged 38 (34.5), 30.5 (29) and 25 (24.5), respectively, in the laboratory and 35 (37) on the balcony.

Tables are given for both species showing the relations between temperature, duration of development, pupal weight, the width of the head-capsule in each of the first four instars and mortality for the examples reared in the laboratory and on the balcony and the average weights of field-collected pupae in 1950–52. Pupal weight was greatest for field-collected material and mortality least among individuals reared at fluctuating temperatures and humidities on the balcony. The head-capsule widths lay within distinct limits for each instar, particularly in *S. liturata*, and were related to pupal weight. *S. liturata* suffered less mortality than *B. piniarus* although conditions were less favourable to it, as shown by a greater difference in pupal weight between examples reared on the balcony and those collected in the field.

B. piniarus is known to have only one generation a year, and field observations are recorded confirming the view that *S. liturata* sometimes produces a partial second generation in autumn [cf. 30 245].

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